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Äspö Hard Rock Laboratory

Prototype Repository

Hydrogeology drill campaign 3A and 3B

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VBB-VIAK

October 1999

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Abstract

The project Prototype Repository is focused on testing and demonstrating the function of the SKB deep repository system. Activities aimed at contributing to development and testing of the practical, engineering measures required to rationally perform the steps of a deposition sequence are also included in the project but are also part of other projects.

The characterisation will be made in three stages. Each stage is intended to contribute to more details useful for the determination of the localisation of the deposition holes and also the boundary and rock conditions needed for the interpretation of the experimental data.

This report describes the hydraulic tests made in the long exploratory boreholes.

The evaluated hydraulic conductivity, of the horizontal boreholes, shows higher values than the evaluated hydraulic conductivity of the vertical bore holes. This is in accordance with the concept that sub-vertical fractures are more conductive than sub-horizontal ones.

In order to estimate the possible inflow to a deposition borehole, two alternate equations assuming radial flow were for each of the six planned deposition boreholes. The two methods give apparently similar results. The geometric mean varies between $5.5 \cdot 10^{-4}$ and 0.12 l/min.

Sammanfattning

Huvudsyftet med projektet Prototypförvar är att testa och demonstrera funktionen av en del av SKB:s djupförvars system. Aktiviteter som syftar till utveckling och försök av praktiska och ingenjörsmässiga lösningar, som krävs för att på ett rationellt sätt kunna stegvis utföra deponeringen av kapslar med kärnbränsle, är inkluderade i projektet för prototypförvaret men även i andra projekt.

Karakteriseringen av bergmassan genomförs i tre steg. Varje steg syftar till att bidra med mer detaljer som skall vara användbara för att kunna lokalisera depositionshål och för att också kunna bestämma randvillkor och bergegenskaper som behövs för att kunna tolka experimentella data.

Denna rapport behandlar resultaten av de hydrauliska testerna i de långa undersöknings borrhålen borrade under det andra steget i karakteriseringen av bergmassan.

Den utvärderade hydrauliska konduktiviteten för subhorisontella borrhål uppvisar högre värden än motsvarande för de subvertikala borrhålen. Detta är i överensstämmelse med den gällande konceptuella modellen att vertikal sprickor är mer konduktiva än horisontella sprickor.

För att möjliggöra en bedömning av inflödet till ett depositionsborrhål har två alternativa ekvationer använts för vardera av de sex planerade depositionsborrhålens lägen. De två olika ekvationerna ger i stort samstämmiga resultat. Det geometriska medelvärdet av inflödet för vardera av de sex borrhålslägena varierar mellan $5.5 \cdot 10^{-4}$ och 0.12 l/min.

Executive Summary

The project Prototype Repository is focused on testing and demonstrating the function of the SKB deep repository system. Activities aimed at contributing to development and testing of the practical, engineering measures required to rationally perform the steps of a deposition sequence are also included in the project but are also part of other projects.

The characterisation will be made in three stages. Each stage is intended to contribute to more details useful for the determination of the localisation of the deposition holes and also the boundary and rock conditions needed for the interpretation of the experimental data. The three stages are:

1. Mapping of the tunnel
2. Pilot and exploratory holes
3. Deposition holes

Stage 1 is completed and stage 2 has been divided into three drilling campaigns:

1. Drilling of pilot holes
2. Drilling of short exploratory holes
3. Drilling of long exploratory holes

This report describes the hydraulic tests that have been made in the long exploratory holes.

The result of the statistical analysis is presented below in *Table 1.* The boreholes were divided into the following subclasses:

1. All boreholes drilled during drilling campaign 1-3

2. Sub-vertical bore holes

3. Sub-horizontal boreholes (KG0021A01, KG0048A01 and KA3548A01)

4. Southerly inclined boreholes (KA3542G01, KA3554G01, KA3566G01 and KA3590G01)

5. Northerly inclined boreholes (KA3542G02, KA3554G02, KA3566G02 and KA3590G02)

Each of these subclasses were statistically analysed using the criteria's below

- Log10 K for 1 m sections (tested as such)

- Log10 K for 3 m sections (tested as such)

- Log10 K for 3 m sections, where the transmissivity of the 1 meter tested sections were added together in series of three to create artificial 3 m sections and then divided by 3 meters. In this manner Log_{10} K for the entire bore hole length was created. In *Table 6-1* the results are detailed.

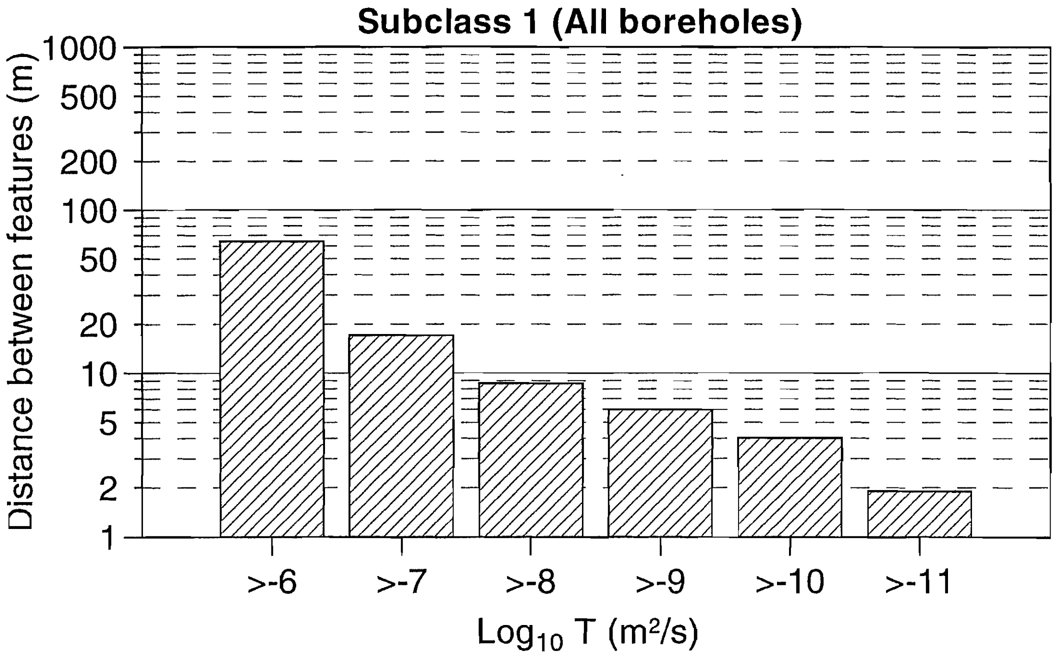
Table 1 Statistical analysis of Log10 K. Scale 1 m and 3 m.

Subclass (see above)	Geometric mean (m/s) 1 m	Standard deviation (Log10 K) 1 m	Geometric mean (m/s) 3 m	Standard deviation (Log10 K) 3 m	Geometric mean (m/s) 1*3 + 3 m	Standard deviation (Log10 K) 1*3 + 3 m
1	$8.5 \cdot 10^{-11}$	1.48	$4.1 \cdot 10^{-10}$	1.83	$3.2 \cdot 10^{-10}$	1.76
2	$2.6 \cdot 10^{-11}$	1.09	$2.5 \cdot 10^{-11}$	1.71	$3.7 \cdot 10^{-11}$	1.47
3	$2.6 \cdot 10^{-9}$	1.91	$2.5 \cdot 10^{-9}$	1.98	$8.7 \cdot 10^{-9}$	1.70
4	$9.0 \cdot 10^{-11}$	1.08	$9.4 \cdot 10^{-10}$	1.83	$6.2 \cdot 10^{-10}$	1.62
5	$1.9 \cdot 10^{-10}$	1.26	$9.1 \cdot 10^{-10}$	1.19	$8.1 \cdot 10^{-10}$	1.28

The horizontal bore holes show considerably higher values of hydraulic conductivity than more vertical bore holes. Observe that the tested sections for the 1 m and 3 m tests are not in the same part of the boreholes. Some distributions are approximately log-normal (generally subclasses with (1*3 + 3 m) and 3 m data sets, but some deviate rather strongly from the log-normal distribution (almost all subclasses with 1 m data sets). For the near field of the prototype tunnel the distributions based on 1*3 + 3 m tests in *Table 1* should be used preferably.

From the measurements of undisturbed pressure sub-vertical boreholes show the lowest pressures and the horizontal boreholes the highest and the inclined have pressures in between. This is in accordance with the concept that the sub-vertical fractures are the most conductive ones.

In order to get estimates of distances between different hydraulic features of a certain magnitude a distance analysis were done. The results of this analysis are shown in *Figure 1 to 3*. The figures show the arithmetic mean of the distance. The analysis is based on the tests with 1 and 3 m tests sections, assuming that the test section represents on a feature. However, there may be one or several conductive fractures in a test section that is treated as one feature in these statistics.



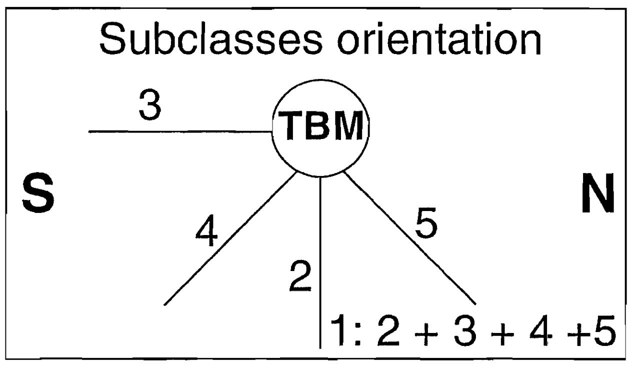


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Figure 1 Arithmetic mean distance between features for all boreholes. S : South, N : North, TBM : prototype tunnel.

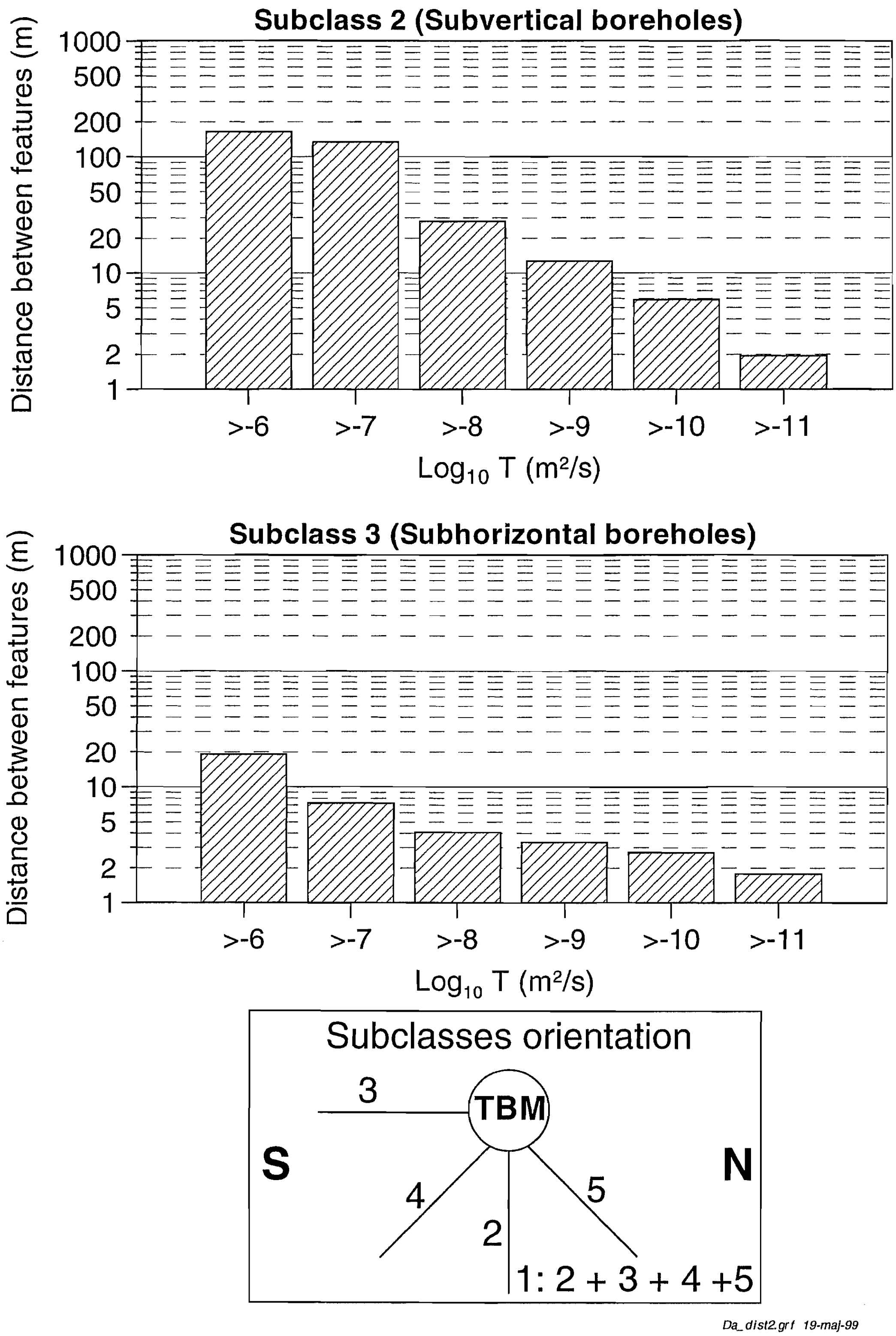


Figure 2 *Arithmetic mean distance between features for horizontal and vertical boreholes. S : South, N : North, TBM : prototype tunnel.*

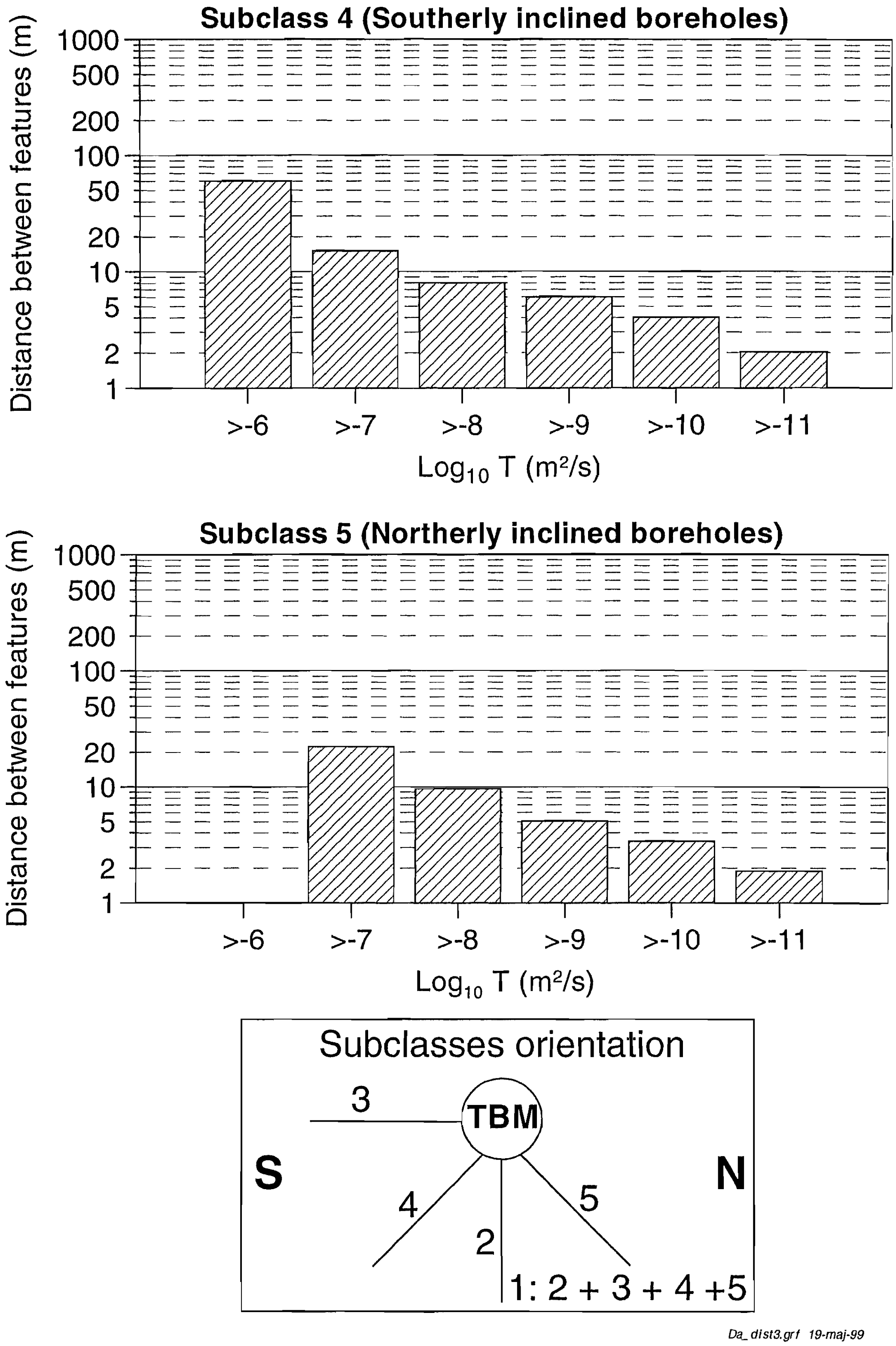


Figure 3 Arithmetic mean distance between features for southerly and northerly inclined boreholes. S : South, N : North, TBM : prototype tunnel.

In order to estimate the inflow to the six deposition bore holes two alternative equations (estimating Q_{d1} and Q_{d2}) have been used for each of them. They both assume radial flow, which should be applicable in this situation for an approximate calculation of the inflow. The results of the calculations for Q_{d2} for depositions bore hole 1 - 6 are shown in *Figure 4 and Figure 5.*

The predicted mean show increases rather much from drill batch 1 to 2 and slightly from drill batch 2 to 3, except for deposition holes 4 and 6 which are almost constant. For deposition boreholes, 1 and 6, the inclined boreholes from drill batch 3 give the extreme values, see *Figures 4 and 5.*

As the exploratory bore hole radius is very small compared with the radius of the deposition boreholes it is likely that the deposition holes will intersect one or several features with as high transmissivity as the highest found in the exploratory boreholes. It is therefor considered that the maximum calculated flow from a single observation hole may be the most relevant prediction for the inflow to the deposition holes. In *Table 2* the maximum calculated flow rates (Q_{d1} and Q_{d2}) for each deposition hole is summarised. The maximum predicted inflow based on the sub-vertical boreholes is about 0.1 - 0.3 l/min. The highest predicted inflows, which are about 1 - 30 l/min are for deposition holes 1 and 6 and are based on two of the inclined boreholes.

The prediction of the inflow based on the evaluated transmissivity gives higher inflow rates compared to the prediction based on the measured flow rate and pressure in the boreholes. The predictions based on the transmissivity gives on average 3 - 4 times higher flow rates but in single cases 2 - 7 times higher flow rates and in two cases 20 and 50 times higher flow rates and in one case 5 times lower flow rates.

Table 2 Maximum calculated flow rate for each deposition bore hole

Deposition bore hole	**Q_{d1} (l/min)**	**Q_{d2} (l/min)**
1=DA3587G01	1.01	20.4
2=DA3581G01	0.00448	0.0119
3=DA3576G01	0.00448	0.0119
4=DA3569G01	0.00513	0.0305
5=DA3551G01	0.0370	0.167
6=DA3545G01	6.55	30.5

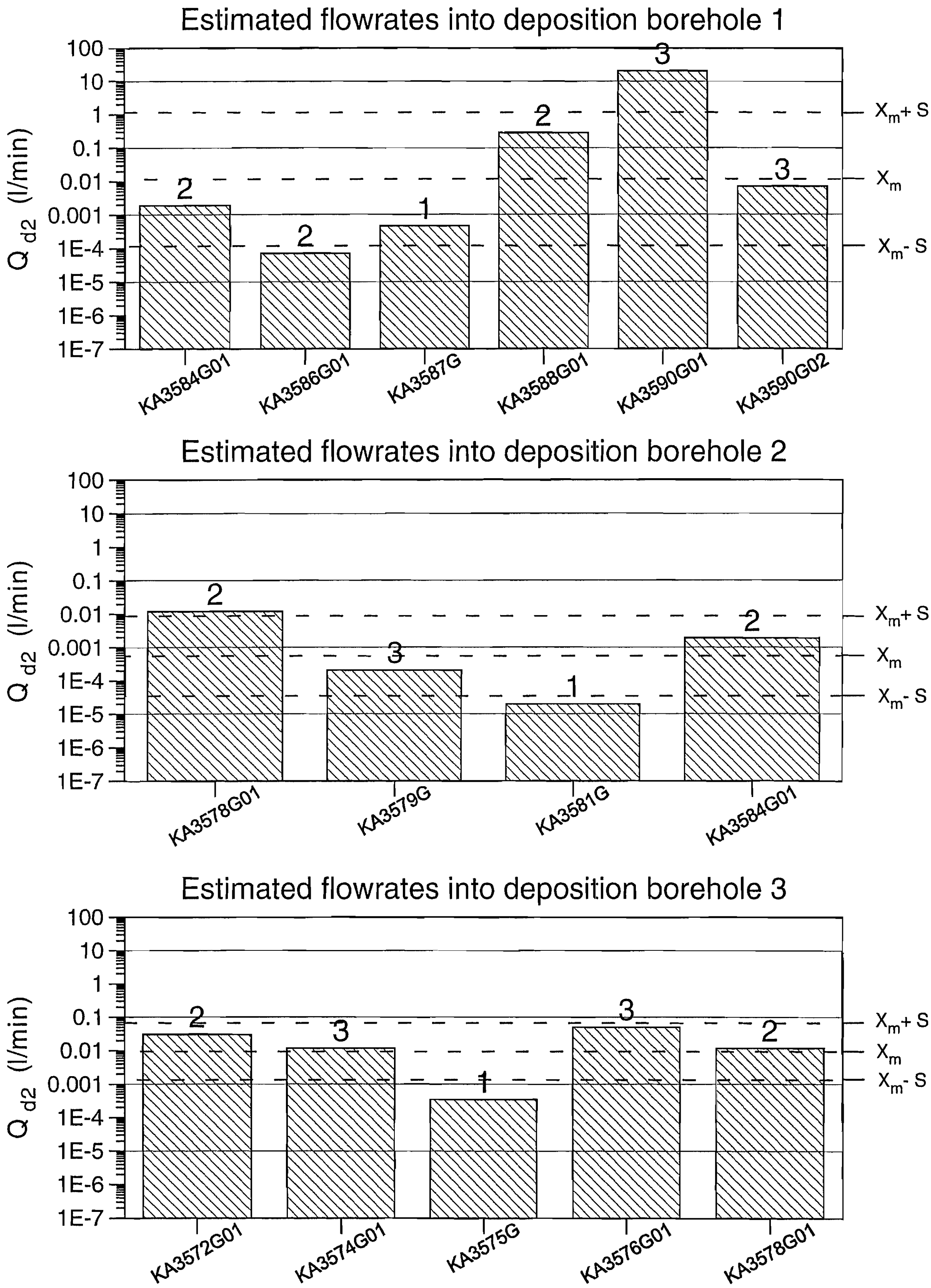


Figure 4 *Estimated flow rates(Q_{d2}) according to Table 7-1 to 7-3. Xm = mean at Log10 (X), S = standard deviation of Log10 (X). 1: drill batch 1, 2: drill batch 2 and 3: drill batch 3.*

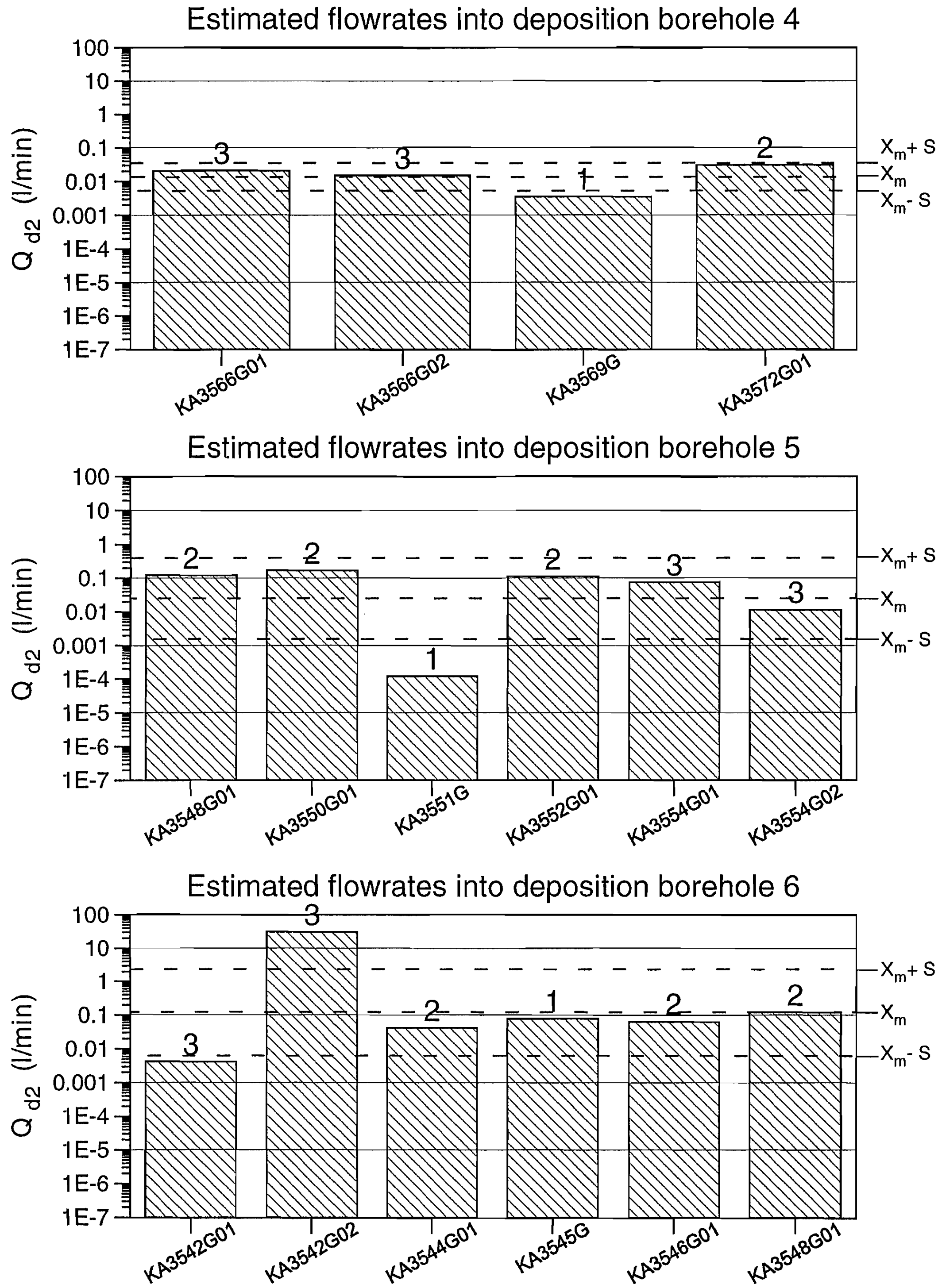


Figure 5 Estimated flow rates(Qd2) according to Table 7-4 to 7-6. Xm = mean at Log10 (X), S = standard deviation of Log10 (X). 1: drill batch 1, 2: drill batch 2 and 3: drill batch 3.

Contents

APPENDICES

List of Figures

List of Tables

1 BACKGROUND

1.1 Äspö Hard Rock Laboratory

In order to prepare for the siting and licensing of a spent fuel repository SKB has constructed an underground research laboratory.

In the autumn of 1990, SKB began the construction of Äspö Hard Rock Laboratory (Äspö HRL) near Oskarshamn in the south-eastern part of Sweden, see *Figure 1-1*. A 3.6 km long tunnel was excavated in crystalline rock down to a depth of approximately 460 m.

The laboratory was completed in 1995 and research concerning the disposal of nuclear waste in crystalline rock has since then been carried out.

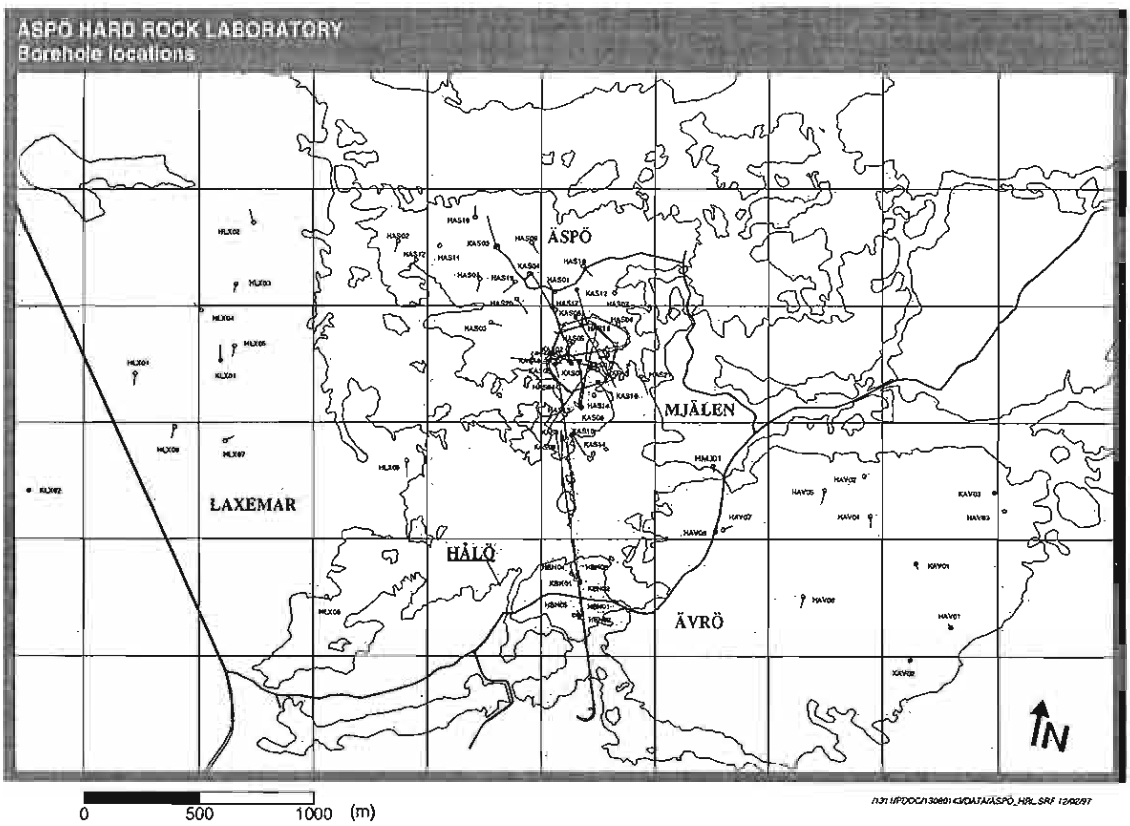


Figure 1-1 Äspö Hard Rock Laboratory

1.2 Prototype repository

Äspö Hard Rock Laboratory is an essential part of the research, development, and demonstration work performed by SKB in preparation for construction and operation of the deep repository for spent fuel. Within the scope of the SKB program for RD&D 1995, SKB has decided to carry out a project with the designation "Prototype Repository". The aim of the project is to test important components in the SKB deep repository system in full scale and in a realistic environment.

The project Prototype Repository is focused on testing and demonstrating the function of the SKB deep repository system. Activities aimed at contributing to development and testing of the practical, engineering measures required to rationally perform the steps of a deposition sequence are also included. However, efforts in this direction are limited, since these matters are addressed in the Demonstration of Repository Technology project and to some extent in the Backfill and Plug Test.

1.2.1 General objectives

The Prototype Repository should simulate as many aspects as possible a real repository, for example regarding geometry, materials, and rock environment. The Prototype Repository is a demonstration of the integrated function of the repository components. Results will be compared with models and assumptions to their validity.

The major objectives for the Prototype Repository are:

- To test and demonstrate the integrated function of the repository components under realistic conditions in full scale and to compare results with models and assumptions.
- To develop, test and demonstrate appropriate engineering standards and quality assurance methods.
- To simulate appropriate parts of the repository design and construction process.

The objectives for the characterisation program are:

- To provide a basis for determination of localisation of the deposition holes
- To provide data on boundary and rock conditions to enable interpretation of the experimental data

1.2.2 Characterisation stages

The characterisation is made in three stages. Each stage is intended to contribute to more details useful for the determination of the localisation of the deposition holes and also the boundary and rock conditions needed for the interpretation of the experimental data. The three stages are:

1. Mapping of the tunnel
2. Pilot and exploratory holes
3. Deposition holes

Stage 1 is completed and stage 2 has been divided into three drilling campaigns:

1. Drilling of pilot holes
2. Drilling of exploratory holes - short bore holes
3. a - Drilling of exploratory holes - long bore holes in TBM Tunnel ;
   b - Drilling of exploratory holes - long bore holes in G tunnel

This report describes the hydraulic tests that have been made in the long exploratory bore holes. The boreholes were drilled during two separate campaigns. Drilling of the boreholes in the TBM tunnel was included in campaign 3a, while the two boreholes being drilled from the G-tunnel and above the TBM tunnel made up the drilling campaign 3b.

2 OBJECTIVE

The objectives of the exploratory bore holes is to obtain data for prediction of the characteristics of the deposition holes, data for modelling and for quantifying the criteria's needed for validation of the suitability of the position for canister deposition. Acceptance of a canister position is based on scrutinization of characterisation data such as fracturing, permeability and stability of the bore hole wall.

The objectives for the hydraulic tests in the long exploratory holes:

- The hydraulic tests of the long exploratory holes shall provide hydrogeological data. These data will be useful for setting up a hydrogeological model of the rock volume around the TBM tunnel, up to a distance of approximately 30 m from the tunnel.
- Data shall together with the geological interpretation form a base for designing specific interference tests with several packed off sections in a number of bore holes and to choose sections for flow measurements during natural conditions and during interference tests.
- The tests shall partly be of similar character as for drill campaign 1 and 2 in order to provide data for statistical treatment of the data.

3 SCOPE

Pressure observations were made during drilling of the long exploratory bore holes. Pressure build-up tests, interference tests and flow logging were performed in the following bore holes located at the end of the TBM tunnel:

Extended pilot boreholes : KA3539G, KA3557G, KA3563G and KA3593G

New boreholes : KA3542G01, KA3542G02, KA3554G01, KA3554G02, KA3566G01, KA3566G02, KA3590G01, KA3590G01 and KA3548A01.

Boreholes drilled from the G-tunnel : KG0021A01 and KG0048A01.

The extended and the new boreholes are approximately 30 m long, while the G-holes are approximately 50 meters long. An additional bore hole, KA3579G, in the TBM tunnel was also utilised during some of the test series. All boreholes have a diameter of 76 mm and are drilled sub-vertically except KA3548A01 and the two G-holes, which are drilled sub-horizontally. As there are no casings in the exploratory bore holes the UHT1 equipment could not be used.

The scope was to evaluate hydraulic tests done in the above mentioned bore holes.

The hydraulic investigations were:

- pressure measurements were made during the drilling of the boreholes
- measurements of the undisturbed pressure in the entire bore hole
- measurements of flow rates from the entire bore hole
- pressure build-up tests of the entire bore hole
- interference tests, with up to 11 observation bore hole sections, were made if the flow rate out of the bore hole exceeded 10 ml/min
- flow logging with packer spacing of 1 or 3 meter
- pressure build-up test of 1 or 3 meter test section if the flow rate out of that particular test section exceeded 10 ml/min
- hydro chemical sampling of 1 or 3 meter test section if the flow rate out of a particular test section exceeds 10 ml/min. These results are not reported in this report.

4 OVERVIEW OF THE TESTS

In this chapter an overview of the tests during drilling campaign 3 is made.

4.1 Tested bore holes

Thirteen new boreholes were drilled during drill campaign 3 and four boreholes were extended. Nine of the new holes are approximately 30 meters long, two are 12 meters long, while the last two are approximately 50 meters long. Each of the extended boreholes is now 30 meters long, *see Figure 4-1 and 4-2.* Tested boreholes during drill campaign 3 are KA3539G, KA3542G01, KA3542G02, KA3548A01, KA3554G01, KA3554G02, KA3557G, KA3563G, KA3566G01, KA3566G02, KA3574G01, KA3576G01, KA3579G, KA3590G01, KA3590G02, KA3593G, KG0021A01 and KG0048A01.

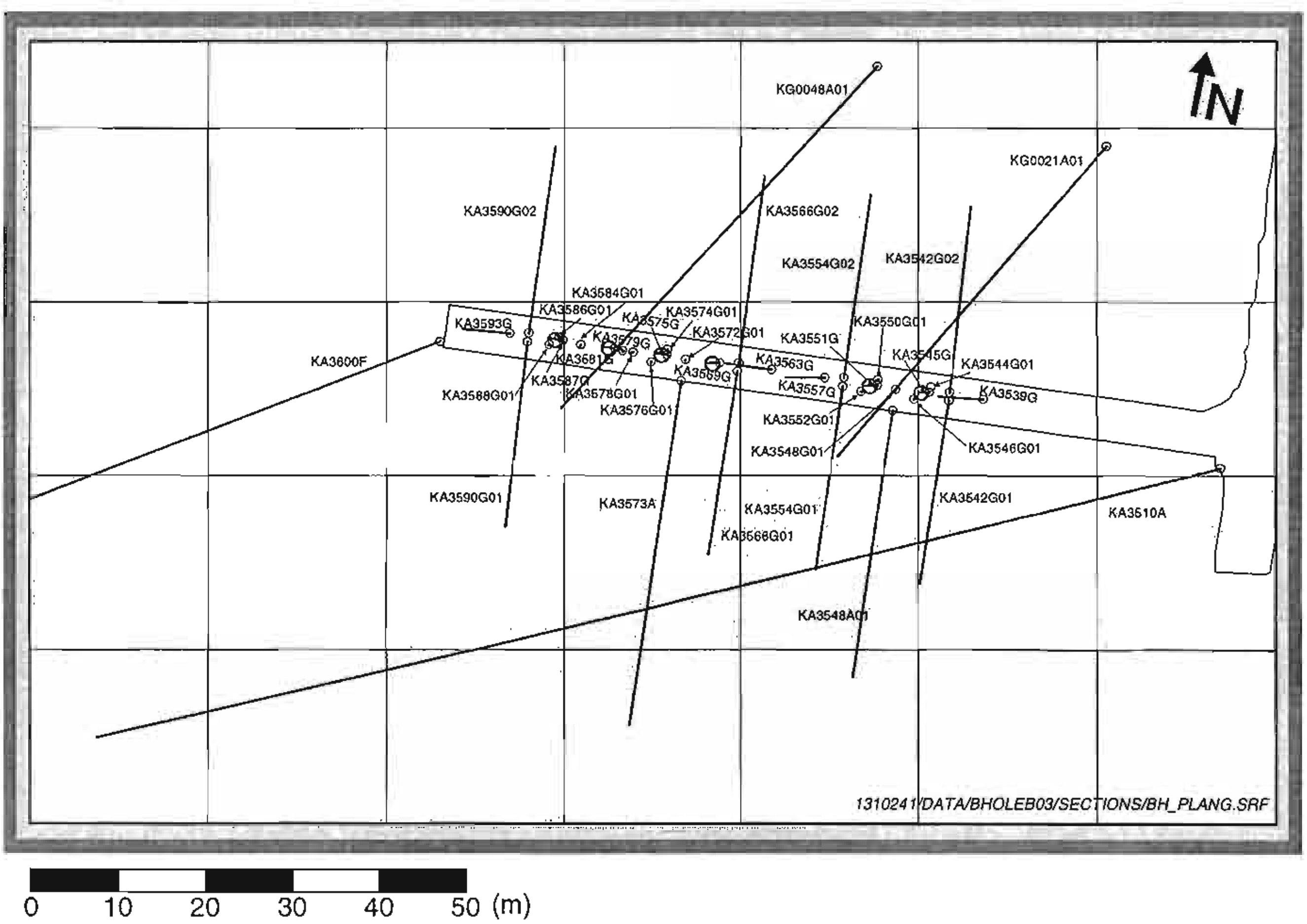


Figure 4-1 Location of the bore holes drilled during drill campaign 1, 2 & 3.

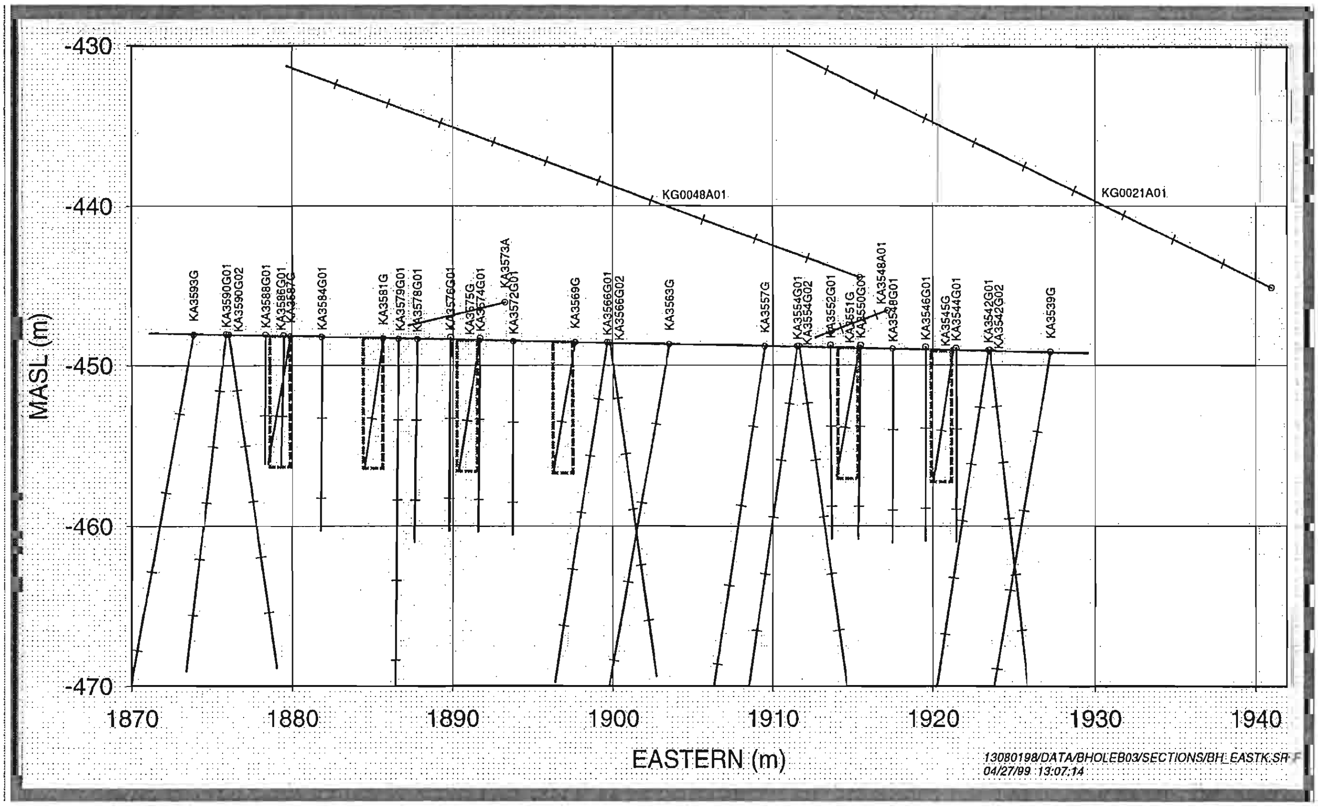


Figure 4-2 Location of the bore holes drilled during drill campaign 1, 2 & 3. Every 5 meter section along the bore hole is indicated.

4.2 Test methodology

4.2.1 Pressure responses during drilling

During drilling of each of the exploratory boreholes 5 - 12 other bore hole sections were used as observation sections. In chapter 5 the pressure responses are presented.

4.2.2 Undisturbed pressure

Prior to the hydraulic tests a mechanical packer was installed in the exploratory bore holes (see *Table 4-2*) and the undisturbed groundwater pressure was measured. The pressure was measured at a point situated at a distance, shown in the *Table 4-1* below, above the tunnel floor. The actual pressure (expressed as meter of water) at tunnel floor level in the test section is then that ”distance” higher than indicated in *Table 4-2*. A few sections show changes in manual readings of the pressures according to *Table 4-2*. Measurement sections are detailed in *Table 5-2*.

Table 4-1 Level of pressure transducers above the tunnel floor during pressure measurements of the entire exploratory holes, drilling campaign 3.

Bore hole	Level above tunnel floor (m)	Bore hole	Level above tunnel floor (m)
KA3539G	1.46	KA3566G01	1.01
KA3542G01	1.01	KA3566G02	1.06
KA3542G02	1.00	KA3572G01	1.47
KA3544G01	1.45	KA3574G01	1.47
KA3545G	1.47	KA3576G01	1.49
KA3546G01	1.47	KA3578G01	1.52
KA3548A01	c. 2	KA3581G	1.51
KA3548G01	0.10	KA3584G01	1.47
KA3550G01	0.10	KA3586G01	1.51
KA3551G	1.46	KA3587G	1.49
KA3552G01	1.35	KA3588G01	1.43
KA3554G01	0.92	KA3590G01	1.00
KA3554G02	1.07	KA3590G02	0.95
KA3557G	1.49	KA3593G	1.45
KA3563G	1.49		

Table 4-2 Bore hole pressures (kPa) measured by pressure gauges or pressure transducer and data logger. The pressure in the test section is higher than the values in the table indicate, see reference levels in *Table 4-1*. (?) indicates an uncertain value.

Date: Time	980630 14:33 –	980630 --16:24
Bore hole	(press.gauge) (kPa)	(pr.transducer) (kPa)
KA3539G	2980	2953
KA3545G	-	2547
KA3544G01	-	2925
KA3546G01	-	2208
KA3548G01	-	2467
KA3551G	10.0	908
KA3550G01	-	2556
KA3552G01	1310	1356
KA3557G	600	605
KA3563G	0	92
KA3569G	930	857
KA3572G01	860(?)	316
KA3574G01	280(?)	94
KA3575G	500	423
KA3576G01	0	55
KA3578G01	0	57
KA3579G	1710	1659
KA3581G	0	-13
KA3584G01	0	-9
KA3587G	1610	1541
KA3586G01	400	330
KA3588G01	2210	2257
KA3593G	239.5	2344
KA3548A01	-	3629
KA3542G01	3810	3770
KA3542G02	3190	3062.5
KA3554G01	-	3837
KA3554G02	3030	2999
KA3566G01	2250	2295
KA3566G02	3390	3325
KA3590G01	2200	2137
KA3590G02	-	3753

4.2.3 Pressure build-up tests of the entire bore hole

Pressure build-up tests of the entire bore holes (i.e. the interval from 0.50 m to the bore hole bottom) were carried out during the summer and autumn of 1998, see *Table 4-4* for details.

Before the measurements, the bore hole pressures were stabilised for about two days

The pressure build-up test cycle was performed as follows:

- the pressure transducers and the data loggers were connected to the flowing bore hole and the two or more nearby bore holes on each side
- the logarithmic scanning option ("SEQ") of the logger was initiated
- The valve of the flowing bore hole was opened and the flow was measured during up to 240 minutes
- the logarithmic scanning option ("SEQ") of the loggers was restarted
- the valve was closed and the pressure build-up was registered during up to 120 minutes
- the data loggers were switched off
- transfer to next bore hole and reconfiguration of the monitoring equipment

The flow rate was measured using graduated cylinders or a Tecalan hose.

The data loggers were programmed to measure with the highest sample rate during the first three minutes of the flow phase and recovery phase respectively. Thereafter the sampling interval was 20 seconds. Since 2-3 transducers were connected to each data logger the lowest measurement interval was 3-4 seconds.

If the flow rate exceeded 10 ml/min the test was performed as an interference test (see *chapter 4.2.4*). If the flow was less, the test was evaluated as a pressure build-up test in the flowing bore hole.

4.2.4 Interference tests

If the water flow rate exceeded 10 ml/minute, following the procedure described in *chapter 4.2.3,* in the entire bore hole an interference test was performed by monitoring of the pressure responses in bore holes on each side of the tested bore hole.

Table 4-4 Listing of hydraulic tests conducted in the exploratory bore holes with the entire bore hole length as test section

Bore hole	Date of test	Type of test	Observation boreholes
KA3539G	980703	I	KA3554G01, KA3554G02, KA3542G01, KA3542G02, KA3548A01, KA3546G01, KA3551G, KA3544G01, KA3545G, KA3510B, KA3573A, KA3600A
KA3542G01	980703	I	KA3542G02, KA3554G01, KA3554G02, KA3548A01, KA3550G01, KA3548G01, KA3546G01, KA3551G, KA3544G01, KA3545G, KA3539G, KA3510B, KA3573A, KA3600A
KA3542G02	980703	I	KA3542G01, KA3554G01, KA3554G02, KA3548A01, KA3550G01, KA3548G01, KA3546G01, KA3551G, KA3544G01, KA3545G, KA3539G, KA3510B, KA3573A, KA3600A
KA3548A01	980705	I	KA3554G01, KA3554G02, KA3542G01, KA3542G02, KA3550G01, KA3548G01, KA3546G01, KA3551G, KA3544G01, KA3545G, KA3539G, KA3510B, KA3573A, KA3600A
KA3554G01	980702	I	KA3554G02, KA3566G01, KA3566G02, KA3557G, KA3552G01, KA3550G01, KA3548A01, KA3551G, KA3548G01, KA3542G01, KA3542G02, KA3510B, KA3573A, KA3600A
KA3554G02	980702	I	KA3554G01, KA3566G01, KA3566G02, KA3557G, KA3552G01, KA3550G01, KA3548A01, KA3551G, KA3548G01, KA3542G01, KA3542G01, KA3510B, KA3573A, KA3600A
KA3557G	980704	PBT	
KA3563G	980706	PBT	
KA3566G01	980702	I	KA356602, KA3590G01, KA3590G02, KA3574G01, KA3554G01, KA3554G02, KA3548A01, KA3569G, KA3557G, KA3563G, KA3572G01, KA3510B, KA3573A, KA3600A
KA3566G02	980701-02	I	KA3566G01, KA3590G01, KA3590G02, KA3574G01, KA3554G01, KA3554G02, KA3548A01, KA3569G, KA3557G, KA3563G, KA3572G01, KA3510B, KA3573A, KA3600A
KA3574G01	980704	PBT	
KA3576G01	980705	PBT	
KA3590G01	980701	I	KA3590G02, KA3593G, KA3588G01, KA3566G01, KA3566G02, KA3548A01, KA3586G01, KA3587G, KA3581G, KA3579G, KA3510B, KA3573A, KA3600A
KA3590G02	980701	I	KA3590G01, KA3593G, KA3588G01, KA3566G01, KA3566G02, KA3548A01, KA3586G01, KA3587G, KA3581G, KA3579G, KA3510B, KA3573A, KA3600A
KA3593G	980701	I	KA3590G01, KA3590G02, KA3588G01, KA3566G01, KA3566G02, KA3548A01, KA3586G01, KA3587G, KA3581G, KA3579G, KA3510B, KA3573A, KA3600A
KG0021A01	981130	I	KA3590G02, KA3566G01, KA3566G02, KA3554G01, KA3554G02, KA3548A01, KA3542G01, KA3542G02, KG0048A01, KA3510B, KA3573A, KA3600A
KG0048A01	981007	I	KA3590G01, KA3590G02, KA3566G01, KA3566G02, KA3554G01, KA3554G02, KA3548A01, KA3542G01, KA3542G02, KG0021A01, KA3510B, KA3573A, KA3600A

PBT = Pressure Build-Up Test, I = Interference Test

4.2.5 Flow logging with double packer system

Flow logging of the fifteen exploratory holes (KA3579G not included) in the TBM was done between June 24 and August 21. KG0048A01 was flow logged 981006 - 981014, KG0021A01 981130 - 981215 while KA3579G finally was flow logged 981216 - 981217. A double packer system with 1 or 3 m packer spacing was used. The bottom section was logged using a single packer. The packers were stabilised for 30 minutes while the flow was measured during 5 minutes.

If the flow rate of the measurement section exceeded 10 ml/min a pressure build-up test was performed. Hydro chemical sampling was done in several sections with flow rates exceeding 10 ml/min

The boreholes were flow logged within the intervals shown in *Tables 5-8 to 5-15.* The first 12 metres were flow logged every 1 meter while from 12 meter and onward 3 meters sections were flow logged.

In 94 sections a flow rate > 10 ml/min was measured and a pressure build-up test was, consequently made, see *Tables 5-7a and 5-7b.*

4.2.6 Flow logging with UCM probe

Several of the core boreholes have been flow logged with a UCM probe developed by SKB (*Almén et al./1991/).* The objectives of the UCM logging was to determine the flow along the core bore holes on order to detect anomalous in flowing and out flowing sections. The following parameters have been measured:

- Flow
- Fluid resitivity
- Temperature

5 RESULTS

In this chapter the results of hydraulic tests in the long exploratory boreholes, in drill campaign 3, are presented and discussed. When the pressure or drawdown is presented as meter of water it is assumed that the density of water = 10^3 kg/m^3 and acceleration of gravity = 10 m/s^2.

5.1 Pressure responses during drilling

During drilling of each of the exploratory boreholes, 5 - 12 other bore hole sections were used as observation sections. In *Table 5-1* the observation boreholes are presented together with the major pressure responses noticed during the drilling. In *Appendix 1* all registered pressure levels are presented for all observation bore holes together with the drilling record of each exploratory borehole.

Only a few certain pressure responses were observed during the drilling. These responses were seen in nearby boreholes for boreholes drilled in the TBM tunnel. The drilling of KG0021A01 and KG0048A01 show influenced observation sections further away than for other drillings.

Table 5-1 Pressure responses during drilling of exploratory boreholes (0 = NO response, 1 = response)

Observation borehole			Drilled borehole										
Bh name	Secup	Seclow	Bhname:	KA3539G	KA3542G01	KA3542G02	KA3542G02	KA3548A01	KA3554G01	KA3554G02	KA3557G	KA3563G	KA3566G01
			Section:	18	19	4.35	12	7	24				
KA3539G	0.39	30.01		X	1	1	1						
KA3542G01	0.39	30.06			X			1					
KA3542G02	0.39	30.05				X	X	1					
KA3544G01	0.39	12.00		1	1	1	1	0			0		
KA3545G	0.39	8.04		1	1	1	1				0		
KA3546G01	0.39	12.00		1	1	1	1		0	0			
KA3548A01	0.25	30.00						X					
KA3548G01	0.25	12.01		1	1	1	1		0	0			
KA3550G01	0.25	12.03		1	1	1	1	0	0	0		0	
KA3551G	0.39	8.04		1	0	0	0		0	0		0	
KA3552G01	0.39	12.01		1				0	0	0	0		
KA3554G01	0.39	30.06						1	X				
KA3554G02	0.39	30.05						1		X			
KA3557G	0.39	30.04							0	0	X		0
KA3563G	0.39	30.00							0	0	0	X	0
KA3566G01	0.39	30.06											X
KA3566G02	0.39	30.05											
KA3569G	0.39	8.04									0	0	0
KA3572G01	0.39	12.00										0	0
KA3574G01	0.39	12.00										0	0
KA3575G	0.39	8.04										0	0
KA3576G01	0.39	12.00										0	0
KA3578G01	0.39	12.58											
KA3579G01	0.00	22.65											
KA3581G	0.39	8.04											
KA3584G01	0.39	12.00											
KA3586G01	0.39	8.00											
KA3587G	0.39	8.04											
KA3588G01	0.39	8.00											
KA3590G01	0.39	30.06											
KA3590G02	0.39	30.05											
KA3593G	0.39	30.02											
KA3510A	0.00	150.00		0	0	0	0	0	0	0	0	0	0
KA3573A:1	18.00	40.00		1	1	0	0	1	1	0	0	0	0
KA3573A:2	4.50	17.00		1	1	0	0	1	1	0	0	0	0
KA3600A:1	22.00	50.10		0	0	0	0	0	0	0	0	0	0
KA3600A:2	4.50	21.00		0	0	0	0	0	0	0	0	0	0

Observation borehole			Drilled borehole										
Bh name	Secup	Seclow	Bhname:	KA3566G02	KA3574G01	KA3576G01	KA3590G01	KA3590G02	KA3593G01	KG0021A01	KG0021A01	KG0048A01	KG0048A01
			Section:			6.8	1.5			25	29	49	54
KA3539G	0.39	30.01											
KA3542G01	0.39	30.06											
KA3542G02	0.39	30.05											
KA3544G01	0.39	12.00											
KA3545G	0.39	8.04											
KA3546G01	0.39	12.00											
KA3548A01	0.25	30.00											
KA3548G01	0.25	12.01											
KA3550G01	0.25	12.03											
KA3551G	0.39	8.04											
KA3552G01	0.39	12.01											
KA3554G01	0.39	30.06											
KA3554G02	0.39	30.05											
KA3557G	0.39	30.04		0									
KA3563G	0.39	30.00		0	0	0							
KA3566G01	0.39	30.06											
KA3566G02	0.39	30.05		X									
KA3569G	0.39	8.04		0	0	0							
KA3572G01	0.39	12.00		0									
KA3574G01	0.39	12.00		0	X								
KA3575G	0.39	8.04		0									
KA3576G01	0.39	12.00		0	0	X							
KA3578G01	0.39	12.58			0	1							
KA3579G01	0.00	22.65			0	0	0	0	0				
KA3581G	0.39	8.04			0	0	0	0	0				
KA3584G01	0.39	12.00			0	0	0	0					
KA3586G01	0.39	8.00					0	0	0				
KA3587G	0.39	8.04				0	1	0	0				
KA3588G01	0.39	8.00					1	0	0				
KA3590G01	0.39	30.06					X						
KA3590G02	0.39	30.05						X					
KA3593G	0.39	30.02					1	0	X				
KA3510A	0.00	150.00		0	0	0	0	0	0	1	0	1	1
KA3573A:1	18.00	40.00		0	0	0	0	0	0	1	0	1	0
KA3573A:2	4.50	17.00		0	0	0	0	0	0	1	0	1	0
KA3600A:1	22.00	50.10		0	0	0	0	0	0	0	1	1	1
KA3600A:2	4.50	21.00		0	0	0	0	0	0	0	1	1	1

5.2 Undisturbed pressures - measured entire bore hole

In the *Table 5-2* below are shown the measured undisturbed pressure shortly before the testing of each bore holes (pressure build-up test of the entire bore hole) commenced, P_0, and the pressure measured before closing the valve after flowing the test section, P_p. The actual pressure in the top of the tunnel floor is Secup + L meters above the values indicated in the table, for reasons described in *chapter 4.2.2.* Pressures are also reported in Appendix 2.

Table 5-2. Undisturbed pressure (P_0) before the tests (10 kPa = 1 m of water)

Bore hole	Secup (m)	Seclow (m)	Level (L) of pressure transducers, for measuring P_0, above tunnel floor (m)	P_0 (m)	P_p (m)
KA3539G	0.39	30.01	1.46	292.18	0.57
KA3542G01	0.39	30.04	1.01	372.75	0.34
KA3542G02	0.39	30.01	1.00	305.16	0.36
KA3548A01	2.56	30.00	2	349.55	0.73
KA3554G01	0.39	30.01	0.92	383.14	0.16
KA3554G02	0.39	30.01	1.07	300.04	0.34
KA3557G	0.39	30.04	1.49	67.67	0.41
KA3563G	0.39	30.00	1.49	9.74	0.43
KA3566G01	0.39	30.01	1.01	229.66	0.08
KA3566G02	0.39	30.01	1.06	332.86	0.19
KA3574G01	0.39	12.00	1.47	44.74	0.48
KA3576G01	0.39	12.01	1.49	7.21	0.33
KA3579G	0.50	22.65	1.20	168.72	0.006
KA3590G01	0.39	30.06	1.00	212.67	0.31
KA3590G02	0.39	30.05	0.95	375.98	0.34
KA3593G	0.39	30.02	1.45	232.91	0.09
KG0021A01	0.00	48.82	0.71	339.45	24.7
KG0048A01	0.00	54.69	0.45	381.30	0.008

The pressure of KA3590G01 is low when compared with the pressures of the feature tests. The reason for this is not known. The pressures of the feature tests in this borehole is within the range 300 – 360 m. As can be further noticed in the table above the pressures varies a lot in the different boreholes. This is an indication of the various inter-connections between fractures of the rock, the tunnel and the boreholes.

In *Figure 5-1* the undisturbed pressures are shown in a diagram.

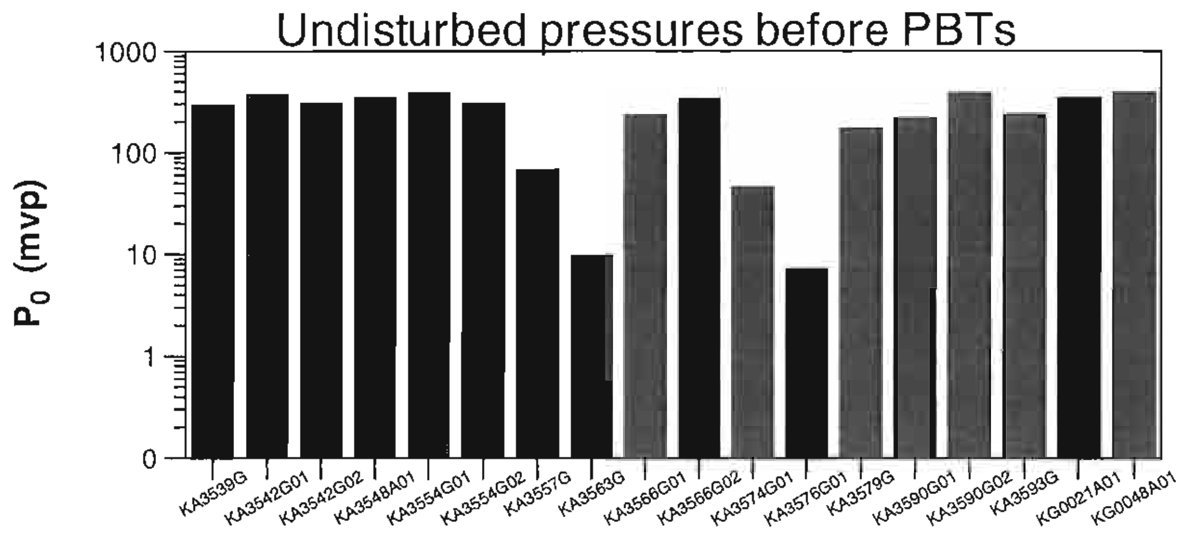


Figure 5-1 Diagram of the undisturbed pressures according to table 5-2.

5.3 Hydraulic tests - measurement section : entire bore hole

The results of the entire bore hole tests are presented in this chapter, and in Appendix 3. The level above tunnel floor for the out-flowing water, L_f, has atmospheric pressure and is shown in Appendix 7. The appendix includes are the tests tested during test campaigns 1, 2, 3a and 3b. The level, L_f, in general is within the interval 0.5 – 2.0 m.

5.3.1 Pressure build-up tests

The flow rates out of the boreholes before the closing of the valve is presented in *Figure 5-2.*

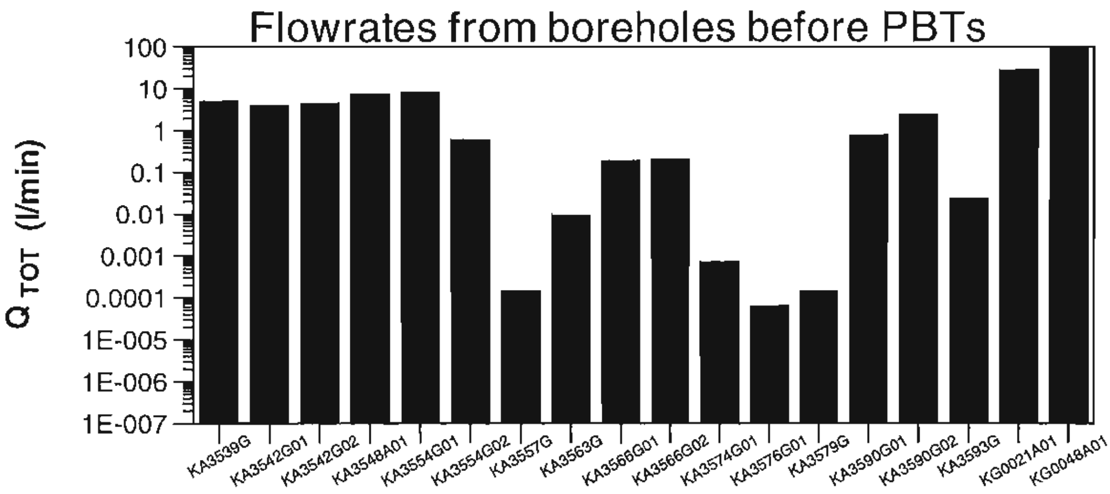


Figure 5-2 Flow rates from the boreholes before PBTs. Measurement sections are according to Table 5-4

The 18 bore holes were all pressure build-up tested. To determine the different flow regimes during the recovery phase the derivative of the pressure was used.

Ten of the tests were possible to make a transmissivity evaluation using a radial flow model. In the remaining eight tests the pressure responses were not possible to evaluate with the radial flow model.

In those bore holes where radial flow occurred a Jacob semi-logarithmic evaluation of the transmissivity were made. In the remaining eight bore holes the transmissivity have been estimated from the specific capacity. The following relationship have been used *Rhén et al /1997/.*

3 - 25 m: $\text{Log}_{10} T = 1.75 + 1.13 \cdot \text{Log}_{10} (Q/s)$ (5-1)

25 - 50 m: $\text{Log}_{10} T = 1.17 + 1.13 \cdot \text{Log}_{10} (Q/s)$ (5-2)

Equations (5-1) and (5-2) are based on tests with test section lengths of 3 - 25 and 25 - 50 m respectively. The evaluated and estimated parameters are shown in *Table 5-4.*

In *Table 5-3* the flow regime evaluation from the evaluated ten tests are presented.

Table 5-3 Flow regime evaluation (WBS = Well Bore Storage, T = Transition, E = Early time, I = Intermediate time, L = Late time)

BOREHOLE	SECUP (m)	SECLOW (m)	TIMEPERIOD Start (min)	Stop (min)	PERIOD (WBS,T,E,I,L)	Flowdim	Comments
KA3542G01	0.39	30.04	0	0.5	WBS	-	
			0.5	10	T,E,I	-	Transition
			10	20	L	2	Radial flow (T_eval)
			20	30	L	-	Transition
KA3548A01	2.56	30.00	0	0.2	WBS	-	
			0.2	7	T,E,I	-	Transition
			7	21	L	2	Radial flow (T_eval)
KA3554G01	0.39	30.01	0	0.1	WBS	-	
			0.1	1.5	T,E,I	-	Transition
			1.5	20	L	2	Radial flow (T_eval)
			20	35	L	-	Transition
KA3554G02	0.39	30.01	0	0.8	WBS	-	
			0.8	2	T,E,I	-	Transition
			2	30	L	2	Radial flow (T_eval)
KA3563G	0.39	30.00	0	1	WBS	-	
			1	10	T,E,I	-	Transition
			10	40	L	2	Radial flow (T_eval)
KA3566G01	0.39	30.01	0	0.8	WBS	-	
			0.8	5	T,E,I	-	Transition
			5	32	L	2	Radial flow (T_eval)
KA3590G01	0.39	30.06	0	0.3	WBS	-	
			0.3	10	T,E,I	-	Transition
			10	25	L	2	Radial flow (T_eval)
KA3593G	0.39	30.02	0	0.7	WBS	-	
			0.7	4	T,E,I	-	Transition
			4	10	L	2	Radial flow (T_eval)
			10	22	L	-	Transition
KG0021A01	0	48.82	0	3	WBS	-	
			3	15	T,E,I	-	Transition
			15	30	L	2	Radial flow (T_eval)
			30	75	L	-	Transition
KG0048A01	0	54.69	0	1	WBS	-	
			1	50	T,E,I	-	Transition
			50	60	L	2	Radial flow (T_eval)

Table 5-4 Evaluated and estimated hydrogeological parameters (s = pressure change, Q = flow rate, Spec_cap = Specific capacity, T(Spec_cap) = transmissivity calculated from equations 5-1 or 5-2, T_eval = evaluated transmissivity where possible)

Borehole	Secup (m)	Seclow (m)	s (m)	Q (l/min)	Spec_cap ($m^3/m \cdot s$)	Log_{10} Spec_cap ($m^3/m \cdot s$)	T(Spec_cap) (m^2/s)	Log_T_Sc (m^2/s)	T_eval (m^2/s)	Log_T_eval (m^2/s)	T_tot (m^2/s)	Log_T_tot (m^2/s)
KA3539G	0.39	30.01	291.16	5.02	2.9E-07	-6.54	6.0E-07	-6.22	-		6.0E-07	-6.22
KA3542G01	0.39	30.04	372.41	3.91	1.7E-07	-6.76	3.4E-07	-6.47	3.2E-07	-6.49	3.2E-07	-6.49
KA3542G02	0.39	30.01	304.80	4.41	2.4E-07	-6.62	4.9E-07	-6.31	-		4.9E-07	-6.31
KA3548A01	2.56	30.00	348.82	7.20	3.4E-07	-6.46	7.4E-07	-6.13	1.0E-06	-6.00	1.0E-06	-6.00
KA3554G01	0.39	30.01	382.98	8.24	3.6E-07	-6.45	7.7E-07	-6.11	2.3E-06	-5.64	2.3E-06	-5.64
KA3554G02	0.39	30.01	299.70	0.602	3.3E-08	-7.48	5.3E-08	-7.28	1.3E-07	-6.89	1.3E-07	-6.89
KA3557G	0.39	30.04	67.26	0.00014	3.5E-11	-10.46	2.2E-11	-10.65	-		2.2E-11	-10.65
KA3563G	0.39	30	9.31	0.009	1.6E-08	-7.79	2.3E-08	-7.64	5.8E-09	-8.24	5.8E-09	-8.24
KA3566G01	0.39	30.01	229.58	0.184	1.3E-08	-7.87	1.9E-08	-7.73	4.7E-08	-7.33	4.7E-08	-7.33
KA3566G02	0.39	30.01	332.67	0.203	1.0E-08	-7.99	1.4E-08	-7.86	-		1.4E-08	-7.86
KA3574G01	0.39	12	44.26	0.00069	2.6E-10	-9.59	8.3E-10	-9.08	-		8.3E-10	-9.08
KA3576G01	0.39	12.01	6.88	0.000063	1.5E-10	-9.82	4.5E-10	-9.34	-		4.5E-10	-9.34
KA3590G01	0.39	30.06	212.36	0.75	5.9E-08	-7.23	1.0E-07	-7.00	1.1E-07	-6.96	1.1E-07	-6.96
KA3590G02	0.39	30.05	375.64	2.35	1.0E-07	-6.98	1.9E-07	-6.72	-		1.9E-07	-6.72
KA3593G	0.39	30.02	232.82	0.023	1.6E-09	-8.78	1.8E-09	-8.76	2.5E-08	-7.60	2.5E-08	-7.60
KG0021A01	0.00	48.82	314.75	26.8	1.4E-06	-5.85	3.6E-06	-5.44	6.0E-07	-6.22	6.0E-07	-6.22
KG0048A01	0.00	54.69	381.30	87.2	3.8E-06	-5.42	1.1E-05	-4.95	8.6E-06	-5.07	8.6E-06	-5.07
KA3579G	0.50	22.65	168.71	0.00014	1.4E-11	-10.86	3.0E-11	-10.52	-		3.0E-11	-10.52

In *Figure 5-3* the evaluated and estimated transmissivity are presented in a diagram.

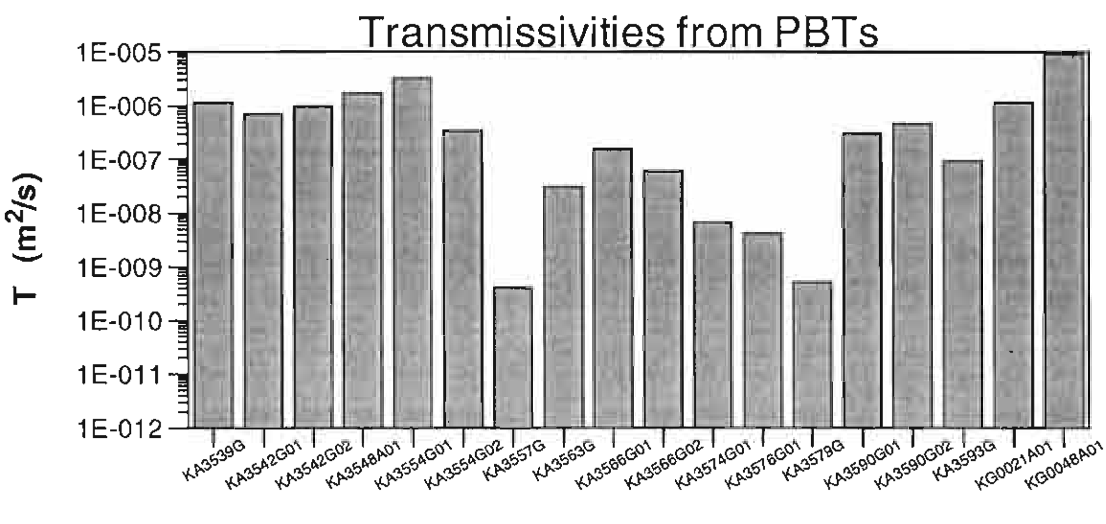


Figure 5-3 Diagram of transmissivity

5.3.2 Interference tests

Pressure registrations were made in the neighbouring bore holes during the flowing and recovery phase of every pressure build-up test. In *Table 5-5* the result of this study is presented. The hydraulic centre of the bore hole has been calculated as the weighted average point of the inflow to the bore hole. The distance, r, between different bore hole sections has been calculated as the spherical distance using co-ordinates for the weighted average point of inflow. The evaluation of T_{EVAL} and S has been made using the Theis log-log type curve method assuming radial flow. The calculation of the hydraulic diffusivity is based on radial flow:

$$\eta = T / S = r^2 / [\, 4 \cdot t_L \cdot (\, 1 + t_L / dt) \cdot \ln(1 + dt / t_L)] \qquad (5\text{-}3)$$

As can be seen in equation the diffusivity is proportional to r^2 / t_L. S^* in the table is calculated as $S^* = T / \eta$. The values of diffusivity and storativity should be seen as approximate values as flow-dimension is not always the radial flow.

Table 5-5a Interference test results for KA3539G. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.)

Flowing borehole	Hydraulic centre of borehole (m)	Flowtime dt (min)	Observation borehole	Hydraulic centre of borehole (m)	r (m)	t_L (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Comments
KA3539G	16.11	64	KA3554G01	24.83	22.41	15	0.558	0.068	-	-	-	Not evaluable
		64	KA3554G02	13.69	17.87	0.55	9.677	0.503	-	-	-	Not evaluable
		64	KA3542G01	21.05	15.51	17	0.236	0.030	-	-	-	Not evaluable
		64	KA3542G02	6.28	12.72	0.11	24.496	0.960	-	-	-	Not evaluable
		64	KA3548A01	15.95	26.53	-	-	-	-	-	-	No response
		64	KA3550G01	6.21	13.81	10	0.318	0.034	-	-	-	Not evaluable
		64	KA3548G01	6.18	12.22	17	0.146	0.019	-	-	-	Not evaluable
		64	KA3546G01	7.42	10.12	20	0.085	0.011	-	-	-	Not evaluable
		64	KA3551G	4.30	15.59	13	0.312	0.036	-	-	-	Not evaluable
		64	KA3544G01	9.75	7.23	0.26	3.351	0.151	-	-	-	Not evaluable
		64	KA3545G	6.25	10.71	-	-	-	-	-	-	No response
		64	KA3510B	117.50	87.74	-	-	-	-	-	-	No response
		64	KA3573A:1	21.34	43.44	27	1.165	0.169	-	-	-	Not evaluable
		64	KA3573A:2	9.16	38.30	17	1.438	0.182	-	-	-	Not evaluable
		64	KA3600A:1	31.78	90.21	-	-	-	-	-	-	No response
		64	KA3600A:2	12.51	72.79	-	-	-	-	-	-	No response

Table 5-5b Interference test results for KA3542G01, KA3542G01 and KA3548A01.

Flowing borehole	Hydraulic centre of borehole (m)	Flowtime dt (min)	Observation borehole	Hydraulic centre of borehole (m)	r (m)	t_L (min)	r^2/t_L (m^2/s)	η (m^2/s)	T_{EVAL} (m^2/s)	S (-)	S^* (-)	Comments
KA3542G01	21.05	60	KA3542G02	6.28	22.94	-	-	-	-	-	-	No response
		60	KA3554G01	24.83	12.43	0.79	3.261	0.185	9.8E-07	1.0E-05	5.3E-06	
		60	KA3554G02	13.69	28.73	1.2	11.464	0.715	-	-	-	Not evaluable
		60	KA3548A01	15.95	17.81	-	-	-	-	-	-	No response
		60	KA3550G01	6.21	20.21	-	-	-	-	-	-	No response
		60	KA3548G01	6.18	18.63	-	-	-	-	-	-	No response
		60	KA3546G01	7.42	16.83	11	0.429	0.049	1.5E-07	4.7E-06	3.1E-06	
		60	KA3551G	4.30	20.76	-	-	-	-	-	-	No response
		60	KA3544G01	9.75	17.16	4.3	1.142	0.098	-	-	-	Not evaluable
		60	KA3545G	6.25	17.97	-	-	-	-	-	-	No response
		60	KA3539G	16.11	15.51	-	-	-	-	-	-	No response
		60	KA3510B	117.50	81.08	3.5	31.304	2.551	-	-	-	Not evaluable
		60	KA3573A:1	21.34	35.67	2.6	8.157	0.614	2.6E-06	3.9E-06	4.2E-06	
		60	KA3573A:2	9.16	35.02	1.7	12.025	0.814	1.2E-06	1.6E-06	1.5E-06	
		60	KA3600A:1	31.78	87.03	23	5.489	0.773	-	-	-	Not evaluable
		60	KA3600A:2	12.51	71.22	10	8.453	0.931	-	-	-	Not evaluable
KA3542G02	6.28	64	KA3542G01	21.05	22.94	31	0.283	0.043	-	-	-	Not evaluable
		64	KA3554G01	24.83	29.00	14	1.001	0.120	-	-	-	Not evaluable
		64	KA3554G02	13.69	13.89	0.12	26.788	1.064	1.5E-07	1.7E-07	1.4E-07	
		64	KA3548A01	15.95	24.91	10	1.034	0.112	-	-	-	Not evaluable
		64	KA3550G01	6.21	9.25	7.9	0.181	0.018	-	-	-	Not evaluable
		64	KA3548G01	6.18	7.94	16	0.066	0.008	-	-	-	Not evaluable
		64	KA3546G01	7.42	7.50	20	0.047	0.006	1.4E-08	5.0E-06	2.2E-06	
		64	KA3551G	4.30	10.08	4.7	0.360	0.031	-	-	-	Not evaluable
		64	KA3544G01	9.75	7.01	0.26	3.149	0.142	1.0E-07	3.4E-06	7.0E-07	
		64	KA3545G	6.25	6.09	24	0.026	0.004	-	-	-	Not evaluable
		64	KA3539G	16.11	12.72	0.16	16.841	0.701	-	-	-	Not evaluable
		64	KA3510B	117.50	95.39	-	-	-	-	-	-	No response
		64	KA3573A:1	21.34	42.20	22	1.349	0.184	-	-	-	Not evaluable
		64	KA3573A:2	9.16	35.06	14	1.464	0.175	-	-	-	Not evaluable
		64	KA3600A:1	31.78	88.43	-	-	-	-	-	-	
		64	KA3600A:2	12.51	70.12	-	-	-	-	-	-	
KA3548A01	15.95	64	KA3554G01	13.69	15.02	1.1	3.418	0.206	1.9E-08	4.8E-06	9.2E-08	
		64	KA3554G02	24.83	41.54	30	0.959	0.143	-	-	-	Not evaluable
		64	KA3542G01	21.05	17.81	0.17	31.084	1.306	6.7E-07	3.2E-07	5.1E-07	
		64	KA3542G02	6.28	24.91	18	0.574	0.074	-	-	-	Not evaluable
		64	KA3550G01	6.21	20.77	44	0.163	0.027	-	-	-	Not evaluable
		64	KA3548G01	6.18	19.94	44	0.151	0.025	-	-	-	Not evaluable
		64	KA3546G01	7.42	19.80	41	0.159	0.026	-	-	-	Not evaluable
		64	KA3551G	4.30	19.52	26	0.244	0.035	-	-	-	Not evaluable
		64	KA3544G01	9.75	22.64	22	0.388	0.053	-	-	-	Not evaluable
		64	KA3545G	6.25	20.28	-			-	-	-	No response
		64	KA3539G	16.11	26.53	17	0.690	0.087	-	-	-	Not evaluable
		64	KA3510B	117.50	86.11	4.9	25.221	2.216	1.9E-05	3.7E-06	8.6E-06	
		64	KA3573A:1	21.34	24.78	0.52	19.681	1.012	5.2E-06	4.9E-06	5.1E-06	
		64	KA3573A:2	9.16	25.08	0.1	104.834	4.049	2.4E-06	1.9E-06	5.9E-07	
		64	KA3600A:1	31.78	79.30	19	5.516	0.721	-	-	-	Not evaluable
		64	KA3600A:2	12.51	70.64	2.9	28.678	2.185	-	-	-	Not evaluable

Table 5-5c Interference test results for KA3554G01, KA3554G02, KA3557G, KA3563G and KA3566G01.

Flowing borehole	Hydraulic centre of borehole (m)	Flowtime dt (min)	Observation borehole	Hydraulic centre of borehole (m)	r (m)	t_L (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Comments
KA3554G01	24.83	64	KA3554G02	13.69	29.35	0.5	28.710	1.465	-	-	-	Not evaluable
		64	KA3566G01	17.15	14.48	1.4	2.496	0.159	2.7E-06	9.3E-06	1.7E-05	
		64	KA3566G02	17.29	33.83	22	0.867	0.118	2.7E-07	4.9E-06	2.3E-06	
		64	KA3557G	11.40	19.47	35	0.180	0.028	-	-	-	Not evaluable
		64	KA3552G01	4.56	21.73	6	1.312	0.122	-	-	-	Not evaluable
		64	KA3550G01	6.21	22.38	-	-	-	-	-	-	No response
		64	KA3548G01	6.18	22.06	-	-	-	-	-	-	No response
		64	KA3551G	4.30	22.63	10	0.854	0.092	-	-	-	Not evaluable
		64	KA3548A01	15.95	19.87	0.33	19.940	0.941	2.2E-06	2.3E-06	2.3E-06	
		64	KA3542G01	21.05	12.43	0.72	3.578	0.197	1.2E-06	1.1E-05	6.1E-06	
		64	KA3542G02	6.28	29.00	14	1.001	0.120	9.1E-07	1.3E-05	7.6E-06	
		64	KA3510B	117.50	69.81	1.2	67.692	4.158	1.9E-05	3.3E-06	4.6E-06	
		64	KA3573A:1	21.34	27.38	0.06	208.164	7.456	4.0E-06	2.6E-05	5.4E-07	
		64	KA3573A:2	9.16	27.79	0.01	1287.233	36.713	2.4E-06	7.8E-07	6.5E-08	
		64	KA3600A:1	31.78	76.00	16	6.017	0.748	-	-	-	Not evaluable
		64	KA3600A:2	12.51	61.03	3.1	20.026	1.553	1.8E-05	3.7E-06	1.2E-05	
KA3554G02	13.69	64	KA3554G01	24.83	29.35	-	-	-	-	-	-	No response
		64	KA3566G01	17.15	25.96	22	0.511	0.070	-	-	-	Not evaluable
		64	KA3566G02	17.29	12.55	1.8	1.459	0.099	1.3E-07	9.5E-07	1.3E-06	
		64	KA3557G	11.40	11.05	22	0.092	0.013	-	-	-	Not evaluable
		64	KA3552G01	4.56	12.38	-	-	-	-	-	-	No response
		64	KA3550G01	6.21	10.71	4.9	0.390	0.034	6.9E-08	2.1E-06	2.0E-06	
		64	KA3548G01	6.18	12.32	10	0.253	0.027	3.5E-08	1.6E-06	1.3E-06	
		64	KA3551G	4.30	11.90	12	0.197	0.022	-	-	-	Not evaluable
		64	KA3548A01	15.95	31.25	-	-	-	-	-	-	No response
		64	KA3542G01	21.05	28.73	-	-	-	-	-	-	No response
		64	KA3542G02	6.28	13.89	0.52	6.182	0.318	3.1E-07	3.2E-07	9.7E-07	Linear flow ?
		64	KA3510B	117.50	87.99	-	-	-	-	-	-	No response
		64	KA3573A:1	21.34	40.33	-	-	-	-	-	-	No response
		64	KA3573A:2	9.16	30.89	-	-	-	-	-	-	No response
		64	KA3600A:1	31.78	79.35	-	-	-	-	-	-	No response
		64	KA3600A:2	12.51	60.80	-	-	-	-	-	-	No response
KA3557G	11.40		No obs.									
KA3563G	5.60		No obs.									
KA3566G01	17.15	63	KA3566G02	17.29	25.64	-	-	-	-	-	-	No response
		63	KA3590G01	4.33	27.19	0.91	13.535	0.785	8.1E-08	5.5E-08	1.0E-07	
		63	KA3590G02	26.73	40.75	-	-	-	-	-	-	No response
		63	KA3574G01	4.93	17.38	-	-	-	-	-	-	No response
		63	KA3554G01	13.69	12.58	10	0.264	0.029	-	-	-	Not evaluable
		63	KA3554G02	24.83	33.53	-	-	-	-	-	-	No response
		63	KA3548A01	15.95	23.13	-	-	-	-	-	-	No response
		63	KA3569G	4.00	15.36	7.4	0.531	0.053	1.1E-08	2.5E-07	2.1E-07	
		63	KA3557G	11.40	15.12	20	0.190	0.025	-	-	-	Not evaluable
		63	KA3563G	5.60	14.73	-	-	-	-	-	-	No response
		63	KA3572G01	7.67	14.62	-	-	-	-	-	-	No response
		63	KA3510B	117.50	67.64	-	-	-	-	-	-	No response
		63	KA3573A:1	21.34	18.80	0.4	14.733	0.722	-	-	-	Not evaluable
		63	KA3573A:2	9.16	15.53	0.1	40.207	1.557	-	-	-	Not evaluable
		63	KA3600A:1	31.78	63.02	-	-	-	-	-	-	No response
		63	KA3600A:2	12.51	47.08	-	-	-	-	-	-	No response

Table 5-5d Interference test results for KA3566G02, KA3574G01, KA3576G01,KA3590G01, and KA3590G02.

Flowing borehole	Hydraulic centre of borehole (m)	Flowtime dt (min)	Observation borehole	Hydraulic centre of borehole (m)	r (m)	t_L (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Comments
KA3566G02	17.29	63	KA3566G01	17.15	25.64	5	2.191	0.194	-	-	-	Not evaluable
		63	KA3590G01	4.33	30.53	3	5.180	0.400	-	-	-	Not evaluable
		63	KA3590G02	26.73	25.65	-	-	-	-	-	-	No response
		63	KA3574G01	4.93	16.36	10	0.446	0.048	-	-	-	Not evaluable
		63	KA3554G01	24.83	33.83	43	0.444	0.073	-	-	-	Not evaluable
		63	KA3554G02	13.69	12.55	3.2	0.821	0.064	2.3E-07	1.4E-06	3.6E-06	
		63	KA3548A01	15.95	38.50	40	0.618	0.100	-	-	-	Not evaluable
		63	KA3569G	4.00	15.43	6.3	0.630	0.060	-	-	-	Not evaluable
		63	KA3557G	11.40	15.43	37	0.107	0.017	-	-	-	Not evaluable
		63	KA3563G	5.60	14.52	0.96	3.662	0.215	-	-	-	Not evaluable
		63	KA3572G01	7.67	14.95	12	0.311	0.036	-	-	-	Not evaluable
		63	KA3510B	117.50	82.22	52	2.167	0.374	-	-	-	Not evaluable
		63	KA3573A:1	21.34	39.76	50	0.527	0.090	-	-	-	Not evaluable
		63	KA3573A:2	9.16	29.06	0.03	469.125	15.323	-	-	-	Not evaluable
		63	KA3600A:1	31.78	69.92	38	2.144	0.342	-	-	-	Not evaluable
		63	KA3600A:2	12.51	51.39	44	1.000	0.166	-	-	-	Not evaluable
KA3574G01	4.93		No obs.									
KA3576G01	5.99		No obs.									
KA3590G01	4.33	62	KA3590G02	26.73	28.06	9.3	1.411	0.151	-	-	-	Not evaluable
		62	KA3593G	6.45	6.01	1.9	0.317	0.022	-	-	-	Not evaluable
		62	KA3588G01	5.18	4.43	10	0.033	0.004	-	-	-	Not evaluable
		62	KA3566G01	17.15	27.19	0.45	27.371	1.377	1.2E-07	5.2E-08	8.7E-08	
		62	KA3566G02	17.29	30.53	4.5	3.453	0.299	-	-	-	Not evaluable
		62	KA3548A01	15.95	44.56	4.5	7.352	0.636	-	-	-	
		62	KA3586G01	4.26	5.47	-	-	-	-	-	-	No response
		62	KA3587G	4.30	5.11	-	-	-	-	-	-	No response
		62	KA3581G	4.22	9.97	-	-	-	-	-	-	No response
		62	KA3579G	7.62	12.29	-	-	-	-	-	-	No response
		62	KA3510B	117.50	69.95	-	-	-	-	-	-	No response
		62	KA3573A:1	21.34	27.20	12	1.028	0.118	-	-	-	Not evaluable
		62	KA3573A:2	9.16	20.04	3.1	2.159	0.169	-	-	-	Not evaluable
		62	KA3600A:1	31.78	40.24	-	-	-	-	-	-	No response
		62	KA3600A:2	12.51	21.80	-	-	-	-	-	-	No response
KA3590G02	26.73	60	KA3590G01	4.33	28.06	-	-	-	-	-	-	No response
		60	KA3593G	6.45	23.37	21	0.433	0.059	-	-	-	Not evaluable
		60	KA3588G01	5.18	24.43	24	0.415	0.059	-	-	-	Not evaluable
		60	KA3566G01	17.15	40.75	8.7	3.180	0.336	-	-	-	Not evaluable
		60	KA3566G02	17.29	25.65	0.72	15.230	0.848	6.2E-08	1.2E-07	7.3E-08	
		60	KA3548A01	15.95	59.93	6.90	8.674	0.856	-	-	-	Not evaluable
		60	KA3586G01	4.26	24.15	-	-	-	-	-	-	No response
		60	KA3587G	4.30	24.36	-	-	-	-	-	-	No response
		60	KA3581G	4.22	25.87	-	-	-	-	-	-	No response
		60	KA3579G	7.62	24.86	-	-	-	-	-	-	No response
		60	KA3510B	117.50	75.70	-	-	-	-	-	-	No response
		60	KA3573A:1	21.34	51.10	20	2.176	0.294	-	-	-	Not evaluable
		60	KA3573A:2	9.16	41.43	14	2.043	0.249	-	-	-	Not evaluable
		60	KA3600A:1	31.78	56.52	25	2.130	0.307	-	-	-	Not evaluable
		60	KA3600A:2	12.51	40.32	35	0.774	0.122	-	-	-	Not evaluable

Table 5-5e Interference test results for KA3593G01, KG0021A01 and KG0048G01.

Flowing borehole	Hydraulic centre of borehole (m)	Flowtime dt (min)	Observation borehole	Hydraulic centre of borehole (m)	r (m)	t_L (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Comments
KA3593G	6.45	64	KA3590G01	4.33	6.01	3.3	0.182	0.014	-	-	-	Not evaluable
		64	KA3590G02	26.73	23.37	-	-	-	-	-	-	No response
		64	KA3588G01	5.18	5.86	0.79	0.724	0.041	8.4E-09	2.3E-07	2.1E-07	
		64	KA3566G01	17.15	30.63	5.5	2.843	0.258	-	-	-	Not evaluable
		64	KA3566G02	17.29	30.71	-	-	-	-	-	-	No response
		64	KA3548A01	15.95	49.36	-	-	-	-	-	-	No response
		64	KA3586G01	4.26	6.98	-	-	-	-	-	-	No response
		64	KA3587G	4.30	6.75	-	-	-	-	-	-	No response
		64	KA3581G	4.22	12.63	-	-	-	-	-	-	No response
		64	KA3579G	7.62	14.11	-	-	-	-	-	-	No response
		64	KA3510B	117.50	68.82	-	-	-	-	-	-	No response
		64	KA3573A:1	21.34	32.76	-	-	-	-	-	-	No response
		64	KA3573A:2	9.16	25.45	-	-	-	-	-	-	No response
		64	KA3600A:1	31.78	39.22	-	-	-	-	-	-	No response
		64	KA3600A:2	12.51	20.97	-	-	-	-	-	-	No response
KG0021A01	27.41	85	KA3590G01	4.33	51.00	-	-	-	-	-	-	No logger
		85	KA3590G02	26.73	57.10	4.00	13.587	1.046	4.1E-07	4.0E-07	3.9E-07	
		85	KA3566G01	17.15	39.83	26.90	0.983	0.131	1.4E-06	1.7E-05	1.1E-05	
		85	KA3566G02	17.29	33.64	9.30	2.029	0.197	2.2E-07	1.6E-06	1.1E-06	
		85	KA3554G01	24.83	41.59	0.96	30.031	1.652	-	-	-	Not evaluable
		85	KA3554G02	13.69	24.54	7.10	1.414	0.127	3.6E-06	3.2E-05	2.8E-05	
		85	KA3548A01:1	19.56	33.18	6.20	2.959	0.256	2.7E-06	1.2E-05	1.1E-05	
		85	KA3548A01:2	13.49	27.50	5.20	2.423	0.200	-	-	-	Not evaluable
		85	KA3542G01	21.05	36.37	7.90	2.790	0.259	-	-	-	Not evaluable
		85	KA3542G02	6.28	21.64	0.48	16.262	0.780	-	-	-	Not evaluable
		85	KA3510A:1	122.50	111.98	16.00	13.062	1.492	-	-	-	Not evaluable
		85	KA3510A:2	117.50	107.22	53.70	3.568	0.576	-	-	-	Not evaluable
		85	KA3510A:3	45.00	44.32	7.10	4.612	0.415	1.9E-06	6.3E-06	4.6E-06	
		85	KA3573A:1	21.34	45.26	10.00	3.415	0.339	6.5E-06	2.0E-05	1.9E-05	
		85	KA3573A:2	9.16	37.28	4.70	4.928	0.396	3.0E-06	9.3E-06	7.6E-06	
		85	KA3600F:1	31.78	89.36	28.20	4.720	0.637	-	-	-	Not evaluable
		85	KA3600F:2	12.51	70.74	18.20	4.582	0.544	-	-	-	Not evaluable
		85	KG0048A01:1	53.81	45.24	8.00	4.264	0.397	2.8E-06	6.0E-06	7.1E-06	
		85	KG0048A01:2	45.89	39.07	3.00	8.479	0.606	2.9E-06	3.7E-06	4.8E-06	
		85	KG0048A01:3	33.50	31.05	1.90	8.455	0.541	5.0E-07	1.2E-06	9.2E-07	
		85	KG0048A01:4	23.64	27.12	1.70	7.213	0.450	2.2E-07	6.7E-07	4.9E-07	
		85	KG0048A01:5	6.50	28.32	1.40	9.546	0.570	-	-	-	Not evaluable
KG0048A01	48.25	65.8	KA3590G01	4.33	20.10	0.30	22.454	1.036	-	-	-	Not evaluable
		65.8	KA3590G02	26.73	41.23	0.66	42.931	2.304	-	-	-	Not evaluable
		65.8	KA3566G01	17.15	33.51	0.38	49.245	2.372	-	-	-	Not evaluable
		65.8	KA3566G02	17.29	35.28	16.60	1.249	0.156	-	-	-	Not evaluable
		65.8	KA3554G01	24.83	46.27	0.28	127.413	5.805	1.5E-06	4.7E-07	2.6E-07	
		65.8	KA3554G02	13.69	39.74	13.20	1.994	0.232	-	-	-	Not evaluable
		65.8	KA3548A01:1	19.56	41.66	0.02	1701.525	51.477	2.1E-06	9.4E-08	4.1E-08	
		65.8	KA3548A01:2	13.49	39.05	1.95	13.032	0.892	1.1E-06	1.4E-06	1.2E-06	
		65.8	KA3542G01	21.05	51.99	3.00	15.015	1.146	9.2E-07	8.8E-07	8.0E-07	
		65.8	KA3542G02	6.28	45.15	9.80	3.467	0.369	-	-	-	Not evaluable
		65.8	KA3510B	117.50	87.79	1.66	77.380	5.093	-	-	-	Not evaluable
		65.8	KA3573A:1	21.34	27.34	0.03	498.317	15.812	2.8E-06	2.0E-06	1.8E-07	
		65.8	KA3573A:2	9.16	19.00	0.00	6016.667	135.577	1.4E-06	3.2E-07	1.0E-08	
		65.8	KA3600F:1	31.78	50.13	1.50	27.922	1.794	-	-	-	Not evaluable
		65.8	KA3600F:2	12.51	32.35	0.20	87.210	3.748	9.5E-06	4.1E-06	2.5E-06	
		65.8	KG0021A01:1	29.13	39.60	0.36	72.596	3.462	-	-	-	Not evaluable
		65.8	KG0021A01:2	11.72	53.42	0.29	164.024	7.520	1.3E-06	2.0E-07	1.7E-07	

5.4 Hydraulic tests - measurement section : 1 or 3 meter

In all bore holes flow logging was made using a double packer system. The packer inflation influences the accuracy of the flow measurements. The generated flow in a double packer section caused by the packers used in the exploratory bore hole tests have been tested in laboratory. These laboratory tests indicate that the packers themselves generate a flow rate which decreases by time and the flow rate is about 0.5 ml/min after 30 minutes expansion, *see Figure 5-4.*

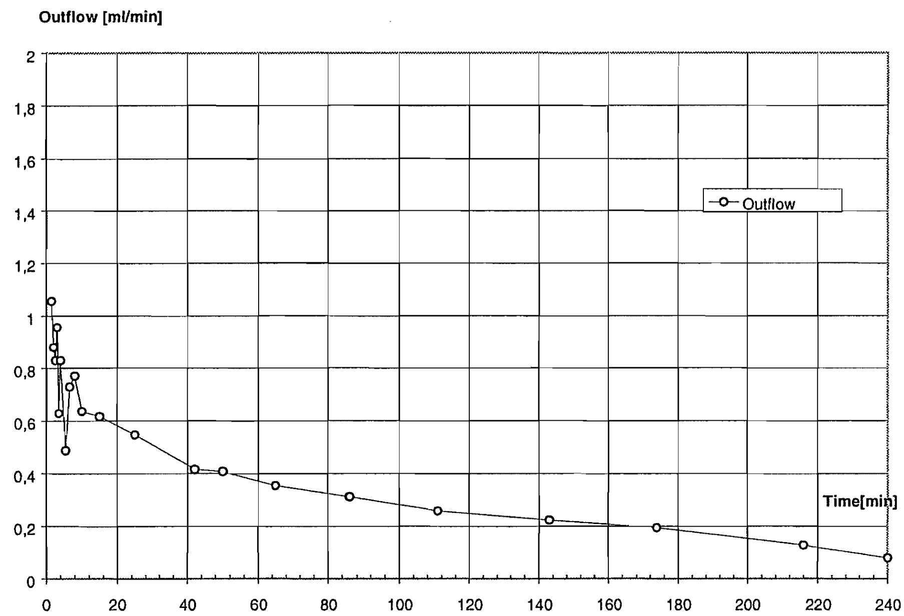


Figure 5-4 Generated flow caused by inflation of double packers PUR 72. Elapsed time from start of inflation

These packers were the same ones used during the first and second test campaign. According to the test results, it is believed that the generated flow from packer expansion must be lower, at least in some cases. The results indicate those flow measurements less than $1 \cdot 10^{-4}$ l/min can possibly be considered as a packer generated flow. In those cases the flow of the section is set to, $Q_m = 1 \cdot 10^{-4}$ l/min, which is considered to be the measurement limit.

The measured flow then used to estimate the transmissivity of the 1 or 3 meter section,

$$T_{sect} = (Q_{sect} \cdot T_{TOT}) / Q_{secttot} \qquad (5\text{-}4)$$

where $Q_{secttot}$ is the accumulated flow for the entire bore hole from the flow logging

T_{TOT} is the estimated transmissivity valid for the entire bore hole.

Q_{sect} is the measured flow from the section, or if less than $1 \cdot 10^{-4}$ l/min, then it is set to $Q_m = 1 \cdot 10^{-4}$ l/min. Q_{sect} is based on Q_m if $Q_{sect} < 10^{-4}$ l/min.

This means that the transmissivity of a section may be lower in some cases when Q_{sect} is set to Q_m.

When extrapolating the last part of the recovery curve up to the total flowing time a pressure, P^*, is received which ought to be more or less the same as the undisturbed pressure before the test. An earlier comparison of the two pressures indicates this, *see Table 5-6*. P_0 was not possible to estimate from the tests in most cases. Pressures are also reported in Appendix 2.

If the flow rate of the measurement section exceeded 10 ml/min a pressure build-up test of the section was done. The results are presented in *Table 5-7.*

In the *Figures 5-5 to 5-9* the results from the tests are summarised and presented.

Tables 5-8 to 5-15 shows the results of flow rate (Q) and transmissivity (T), visualised in *Figures 5-5 to 5-9.*

Table 5-6a Estimated undisturbed pressure before the feature tests. L=level of pressure transducer above tunnel floor, P_0=pressure measured before test, P* = estimated pressure based on extrapolation of the pressure build-up curve.

Borehole	SECUP	SECLOW	L	P0	P*
	(m)	(m)	(m)	(m)	(m)
KA3539G	11.00	12.00	0.10		164
KA3539G	12.00	15.00	0.10		160.5
KA3539G	15.00	18.00	0.10		267
KA3539G	18.00	21.00	0.10		112
KA3539G	21.00	24.00	0.10		112
KA3542G01	12.00	15.00	0.00		272.5
KA3542G01	15.00	18.00	0.00		320
KA3542G01	18.00	21.00	0.00		341
KA3542G01	21.00	24.00	0.00		322.5
KA3542G01	27.00	30.00	0.00		372.5
KA3542G02	3.00	4.00	0.10		192
KA3542G02	4.00	5.00	0.10		286
KA3542G02	5.00	6.00	0.10		285
KA3542G02	10.00	11.00	0.00		271
KA3542G02	11.00	12.00	0.00		258
KA3542G02	12.00	15.00	0.00		230
KA3542G02	15.00	18.00	0.00		242
KA3542G02	18.00	21.00	0.00		214
KA3542G02	24.00	27.00	0.00		215
KA3548A01	5.00	6.00	0.06		280
KA3548A01	6.00	7.00	0.06		113
KA3548A01	9.00	10.00	0.06		368
KA3548A01	12.00	15.00	0.06		366
KA3548A01	15.00	18.00	0.06		367
KA3548A01	18.00	21.00	0.06		377
KA3548A01	21.00	24.00	0.06		375
KA3548A01	24.00	27.00	0.06		382
KA3554G01	18.00	21.00	0.12		352
KA3554G01	21.00	24.00	0.12		370
KA3554G01	24.00	27.00	0.12		382
KA3554G01	27.00	30.00	0.12		368
KA3554G02	8.00	9.00	0.14		344
KA3554G02	11.00	12.00	0.14		317
KA3554G02	12.00	15.00	0.14		315
KA3554G02	15.00	18.00	0.14		310
KA3566G01	13.00	16.00	0.17		186
KA3566G01	16.00	19.00	0.17		222
KA3566G01	19.00	22.00	0.17		244
KA3566G02	15.00	18.00	0.17		354
KA3566G02	18.00	21.00	0.17		355
KA3566G02	21.00	24.00	0.17		330

Table 5-6b Estimated undisturbed pressure before the feature tests. L=level of pressure transducer above tunnel floor, P_0=pressure measured before test, P* = estimated pressure based on extrapolation of the pressure build-up curve.

Borehole	SECUP	SECLOW	L	P0	P*
	(m)	(m)	(m)	(m)	(m)
KA3590G01	1.00	2.00	0.17		174
KA3590G01	2.00	3.00	0.17		75
KA3590G01	5.00	6.00	0.17		305
KA3590G01	8.00	9.00	0.17		343
KA3590G01	9.00	10.00	0.20		338
KA3590G01	21.00	24.00	0.20		361
KA3590G02	12.00	15.00	0.18		126
KA3590G02	18.00	21.00	0.18		210
KA3590G02	24.00	27.00	0.18		305
KA3590G02	27.00	30.00	0.18		279
KA3593G	21.00	24.00	0.20		151
KG0021A01	7.00	10.00	0.71	322.92	
KG0021A01	10.00	13.00	0.71	295.00	
KG0021A01	19.00	20.00	0.71	338.81	
KG0021A01	20.00	21.00	0.71	334.49	
KG0021A01	21.00	22.00	0.71	322.25	
KG0021A01	22.00	23.00	0.71	337.77	
KG0021A01	23.00	24.00	0.71	337.24	
KG0021A01	24.00	25.00	0.71	316.55	
KG0021A01	25.00	26.00	0.71	295.60	
KG0021A01	26.00	27.00	0.71	334.53	
KG0021A01	27.00	28.00	0.71	338.31	
KG0021A01	28.00	29.00	0.71	344.51	
KG0021A01	29.00	30.00	0.71	316.00	
KG0021A01	30.00	31.00	0.71	311.08	
KG0021A01	31.00	32.00	0.71	330.53	
KG0021A01	32.00	33.00	0.71	335.61	
KG0021A01	33.00	34.00	0.71	335.22	
KG0021A01	35.00	36.00	0.71	337.11	
KG0021A01	36.00	37.00	0.71	306.50	
KG0021A01	37.00	38.00	0.71	338.83	
KG0021A01	38.00	39.00	0.71	334.92	
KG0021A01	40.00	41.00	0.71	343.94	
KG0021A01	42.00	43.00	0.71	310.52	
KG0021A01	43.00	44.00	0.71	313.20	
KG0021A01	44.00	45.00	0.71	347.98	
KG0021A01	45.00	46.00	0.71	361.68	

Table 5-6c Estimated undisturbed pressure before the feature tests. L=level of pressure transducer above tunnel floor, P_0=pressure measured before test, P* = estimated pressure based on extrapolation of the pressure build-up curve.

Borehole	SECUP	SECLOW	L	P0	P*
	(m)	(m)	(m)	(m)	(m)
KG0048A01	5.00	8.00	0.45	290.10	
KG0048A01	17.00	20.00	0.45	372.38	
KG0048A01	20.00	23.00	0.45	373.07	
KG0048A01	23.00	24.00	0.45	326.62	
KG0048A01	24.00	25.00	0.45	374.66	
KG0048A01	27.00	28.00	0.45	330.36	
KG0048A01	33.00	34.00	0.45	372.43	
KG0048A01	41.00	42.00	0.45	357.75	
KG0048A01	43.00	44.00	0.45	366.11	
KG0048A01	44.00	45.00	0.45	377.06	
KG0048A01	45.00	46.00	0.45	358.44	
KG0048A01	46.00	47.00	0.45	345.86	
KG0048A01	47.00	48.00	0.45	370.26	
KG0048A01	50.00	51.00	0.45	373.65	
KG0048A01	53.00	54.69	0.45	370.05	

Table 5-7a Result from the part of bore hole pressure build-up tests (s = pressure change, Q = flow rate, Spec_cap = Specific capacity, T(Spec_cap) = transmissivity calculated from eq. 5-1, T_eval = evaluated transmissivity where possible).

Borehole	Secup (m)	Seclow (m)	s (m)	Q (l/min)	Spec_cap ($m^3/m \cdot s$)	T(Spec_cap) (m^2/s)	T_eval (m^2/s)	T_tot (m^2/s)
KA3539G	11	12	164.00	0.088	8.9E-09	4.5E-08	4.5E-08	4.5E-08
KA3539G	12	15	160.50	0.035	3.6E-09	1.6E-08	7.6E-08	7.6E-08
KA3539G	15	18	267.00	4.062	2.5E-07	2.0E-06	2.5E-06	2.5E-06
KA3539G	18	21	112.00	0.046	6.8E-09	3.3E-08		3.3E-08
KA3539G	21	24	112.00	0.026	3.9E-09	1.8E-08	8.7E-08	8.7E-08
KA3542G01	12	15	272.50	0.044	2.7E-09	1.2E-08		1.2E-08
KA3542G01	15	18	320.00	0.538	2.8E-08	1.6E-07	2.0E-07	2.0E-07
KA3542G01	18	21	341.00	1.238	6.1E-08	3.9E-07	3.0E-07	3.0E-07
KA3542G01	21	24	322.50	1.19	6.1E-08	4.0E-07		4.0E-07
KA3542G01	27	30	372.50	0.407	1.8E-08	1.0E-07		1.0E-07
KA3542G02	3	4	192.00	0.125	1.1E-08	5.6E-08	8.4E-08	8.4E-08
KA3542G02	4	5	286.00	0.121	7.1E-09	3.5E-08	9.8E-08	9.8E-08
KA3542G02	5	6	285.00	2.535	1.5E-07	1.1E-06	4.9E-07	4.9E-07
KA3542G02	10	11	271.00	0.056	3.4E-09	1.5E-08	1.5E-08	1.5E-08
KA3542G02	11	12	258.00	0.76	4.9E-08	3.1E-07	1.9E-07	1.9E-07
KA3542G02	12	15	230.00	0.021	1.5E-09	6.1E-09		6.1E-09
KA3542G02	15	18	242.00	0.077	5.3E-09	2.5E-08		2.5E-08
KA3542G02	18	21	214.00	0.035	2.7E-09	1.2E-08		1.2E-08
KA3542G02	24	27	215.00	0.0145	1.1E-09	4.3E-09		4.3E-09
KA3548A01	5	6	280.00	0.126	7.5E-09	3.7E-08		3.7E-08
KA3548A01	6	7	113.00	0.027	4.0E-09	1.8E-08		1.8E-08
KA3548A01	9	10	368.00	1.910	8.7E-08	5.9E-07	1.1E-07	1.1E-07
KA3548A01	12	15	366.00	0.053	2.4E-09	1.0E-08	7.5E-08	7.5E-08
KA3548A01	15	18	367.00	0.212	9.6E-09	4.9E-08	7.8E-07	7.8E-07
KA3548A01	18	21	377.00	3.400	1.5E-07	1.1E-06	2.5E-06	2.5E-06
KA3548A01	21	24	375.00	0.116	5.2E-09	2.4E-08	1.7E-07	1.7E-07
KA3548A01	24	27	382.00	0.017	7.4E-10	2.7E-09		2.7E-09
KA3554G01	18	21	352.00	0.14	6.6E-09	3.2E-08	2.2E-07	2.2E-07
KA3554G01	21	24	370.00	1.53	6.9E-08	4.5E-07	1.3E-06	1.3E-06
KA3554G01	24	27	382.00	6.8	3.0E-07	2.4E-06	2.7E-06	2.7E-06
KA3554G01	27	30	368.00	0.011	5.0E-10	1.7E-09		1.7E-09
KA3554G02	8	9	344.00	0.044	2.1E-09	8.9E-09		8.9E-09
KA3554G02	11	12	317.00	0.128	6.7E-09	3.3E-08	2.9E-07	2.9E-07
KA3554G02	12	15	315.00	0.334	1.8E-08	9.8E-08	3.8E-07	3.8E-07
KA3554G02	15	18	310.00	0.0243	1.3E-09	5.1E-09	4.9E-08	4.9E-08
KA3554G02	27	30	-*	0.0344	-			
KA3566G01	13	16	186.00	0.0322	2.9E-09	1.3E-08	3.8E-08	3.8E-08
KA3566G01	16	19	222.00	0.091	6.8E-09	3.3E-08		3.3E-08
KA3566G01	19	22	244.00	0.0146	1.0E-09	3.8E-09	5.3E-08	5.3E-08
KA3566G02	15	18	354.00	0.109	5.1E-09	2.4E-08	5.0E-09	5.0E-09
KA3566G02	18	21	355.00	0.021	9.9E-10	3.7E-09		3.7E-09
KA3566G02	21	24	330.00	0.019	9.6E-10	3.6E-09		3.6E-09

* = no data

Table 5-7b Result from the part of bore hole pressure build-up tests (s = pressure change, Q = flow rate, Spec_cap = Specific capacity, T(Spec_cap) = transmissivity calculated from eq. 5-1, T_eval = evaluated transmissivity where possible).

Borehole	Secup (m)	Seclow (m)	s (m)	Q (l/min)	Spec_cap ($m^3/m\cdot s$)	T(Spec_cap) (m^2/s)	T_eval (m^2/s)	T_tot (m^2/s)
KA3590G01	1	2	174.00	0.394	3.8E-08	2.3E-07	3.8E-07	3.8E-07
KA3590G01	2	3	75.00	0.032	7.1E-09	3.5E-08	4.2E-08	4.2E-08
KA3590G01	5	6	305.00	0.002	1.1E-10	3.1E-10		3.1E-10
KA3590G01	8	9	343.00	0.2	9.7E-09	5.0E-08		5.0E-08
KA3590G01	9	10	338.00	0.011	5.4E-10	1.9E-09	3.8E-08	3.8E-08
KA3590G01	21	24	361.00	0.012	5.5E-10	2.0E-09		2.0E-09
KA3590G02	12	15	126.00	0.0315	4.2E-09	1.9E-08	8.0E-09	8.0E-09
KA3590G02	18	21	210.00	0.037	2.9E-09	1.3E-08	6.4E-09	6.4E-09
KA3590G02	24	27	305.00	1.035	5.7E-08	3.6E-07	9.9E-08	9.9E-08
KA3590G02	27	30.05	279.00	1.11	6.6E-08	4.3E-07	3.0E-07	3.0E-07
KA3593G	21	24	151.00	0.0148	1.6E-09	6.6E-09		6.6E-09
KG0021A01	7	10	320.76	0.078	4.1E-09	1.8E-08	7.1E-08	7.1E-08
KG0021A01	10	13	294.36	5.78	3.3E-07	2.6E-06	4.7E-07	4.7E-07
KG0021A01	19	20	278.04	0.017	1.0E-09	3.9E-09		3.9E-09
KG0021A01	20	21	276.70	0.0205	1.2E-09	4.8E-09	8.8E-08	8.8E-08
KG0021A01	21	22	263.50	0.0212	1.3E-09	5.3E-09	1.8E-08	1.8E-08
KG0021A01	22	23	280.24	0.0272	1.6E-09	6.5E-09	4.2E-08	4.2E-08
KG0021A01	23	24	279.64	0.038	2.3E-09	9.6E-09	2.2E-08	2.2E-08
KG0021A01	24	25	256.69	0.0215	1.4E-09	5.5E-09	2.0E-08	2.0E-08
KG0021A01	26	27	276.93	0.066	4.0E-09	1.8E-08	9.2E-08	9.2E-08
KG0021A01	27	28	293.01	17.9	1.0E-06	9.5E-06	1.1E-06	1.1E-06
KG0021A01	28	29	297.19	16.41	9.2E-07	8.5E-06	1.1E-06	1.1E-06
KG0021A01	29	30	270.36	12.94	8.0E-07	7.2E-06	5.4E-07	5.4E-07
KG0021A01	30	31	266.42	6.88	4.3E-07	3.6E-06	5.0E-07	5.0E-07
KG0021A01	31	32	272.65	0.044	2.7E-09	1.2E-08	5.1E-08	5.1E-08
KG0021A01	32	33	277.96	0.0815	4.9E-09	2.3E-08	2.3E-07	2.3E-07
KG0021A01	33	34	277.53	0.01	6.0E-10	2.1E-09		2.1E-09
KG0021A01	35	36	290.84	1.38	7.9E-08	5.3E-07		5.3E-07
KG0021A01	36	37	255.93	0.056	3.6E-09	1.6E-08	6.3E-08	6.3E-08
KG0021A01	37	38	287.69	0.012	7.0E-10	2.5E-09	8.0E-08	8.0E-08
KG0021A01	38	39	279.66	0.32	1.9E-08	1.1E-07		1.1E-07
KG0021A01	40	41	280.20	1.0104	6.0E-08	3.9E-07		3.9E-07
KG0021A01	42	43	248.87	0.05	3.3E-09	1.5E-08	2.1E-08	2.1E-08
KG0021A01	43	44	258.24	0.315	2.0E-08	1.1E-07		1.1E-07
KG0021A01	44	45	290.70	0.0146	8.4E-10	3.1E-09		3.1E-09
KG0021A01	45	46	299.59	0.0112	6.2E-10	2.2E-09		2.2E-09
KG0048A01	5	8	287.63	5.2	3.0E-07	2.4E-06	8.7E-07	8.7E-07
KG0048A01	17	20	370.23	0.078	3.5E-09	1.6E-08		1.6E-08
KG0048A01	20	23	371.03	0.106	4.8E-09	2.2E-08	1.7E-07	1.7E-07
KG0048A01	23	24	324.15	0.097	5.0E-09	2.3E-08		2.3E-08
KG0048A01	24	25	372.28	0.624	2.8E-08	1.6E-07	4.4E-07	4.4E-07
KG0048A01	27	28	328.25	0.0253	1.3E-09	5.0E-09		5.0E-09
KG0048A01	33	34	368.25	1.67	7.6E-08	5.0E-07		5.0E-07
KG0048A01	41	42	354.84	0.024	1.1E-09	4.4E-09	2.1E-08	2.1E-08
KG0048A01	43	44	302.58	0.08	4.4E-09	2.0E-08	2.5E-08	2.5E-08
KG0048A01	44	45	334.52	0.204	1.0E-08	5.2E-08	4.7E-07	4.7E-07
KG0048A01	45	46	353.02	21.89	1.0E-06	9.7E-06	2.8E-06	2.8E-06
KG0048A01	46	47	342.12	15	7.3E-07	6.5E-06	2.4E-06	2.4E-06
KG0048A01	47	48	304.56	0.164	9.0E-09	4.5E-08	2.7E-07	2.7E-07
KG0048A01	50	51	282.47	0.561	3.3E-08	2.0E-07	1.9E-06	1.9E-06
KG0048A01	53	54.69	339.33	62.9	3.1E-06	3.3E-05	3.8E-06	3.8E-06

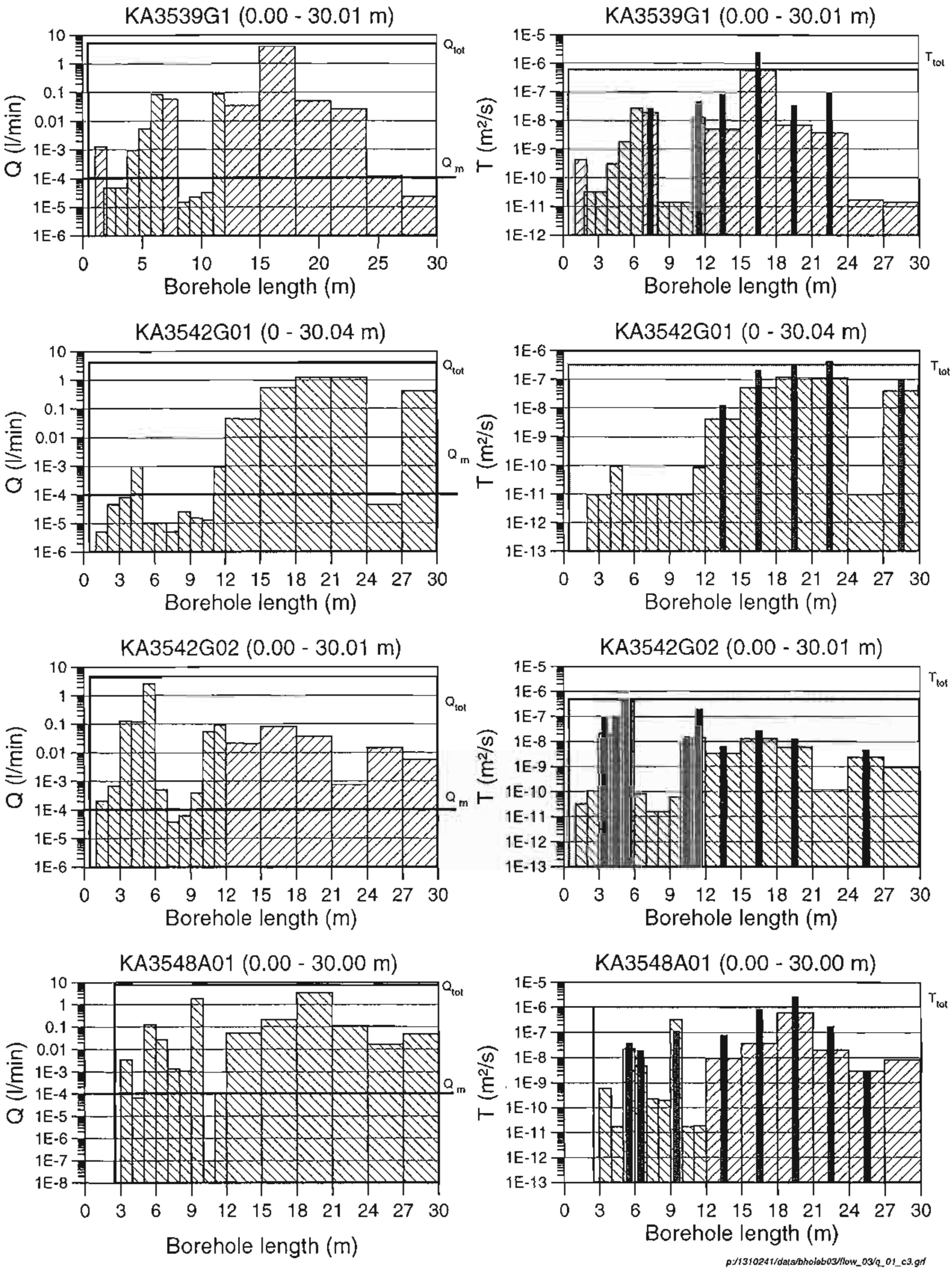


Figure 5-5 Test results of KA3539G, KA3542G01, KA3542G01 and KA3548A01. Q_m = estimated meas. Limit, Q_{TOT} = measurement of entire bore hole, T_{TOT} = estimated transmissivity of entire bore hole.

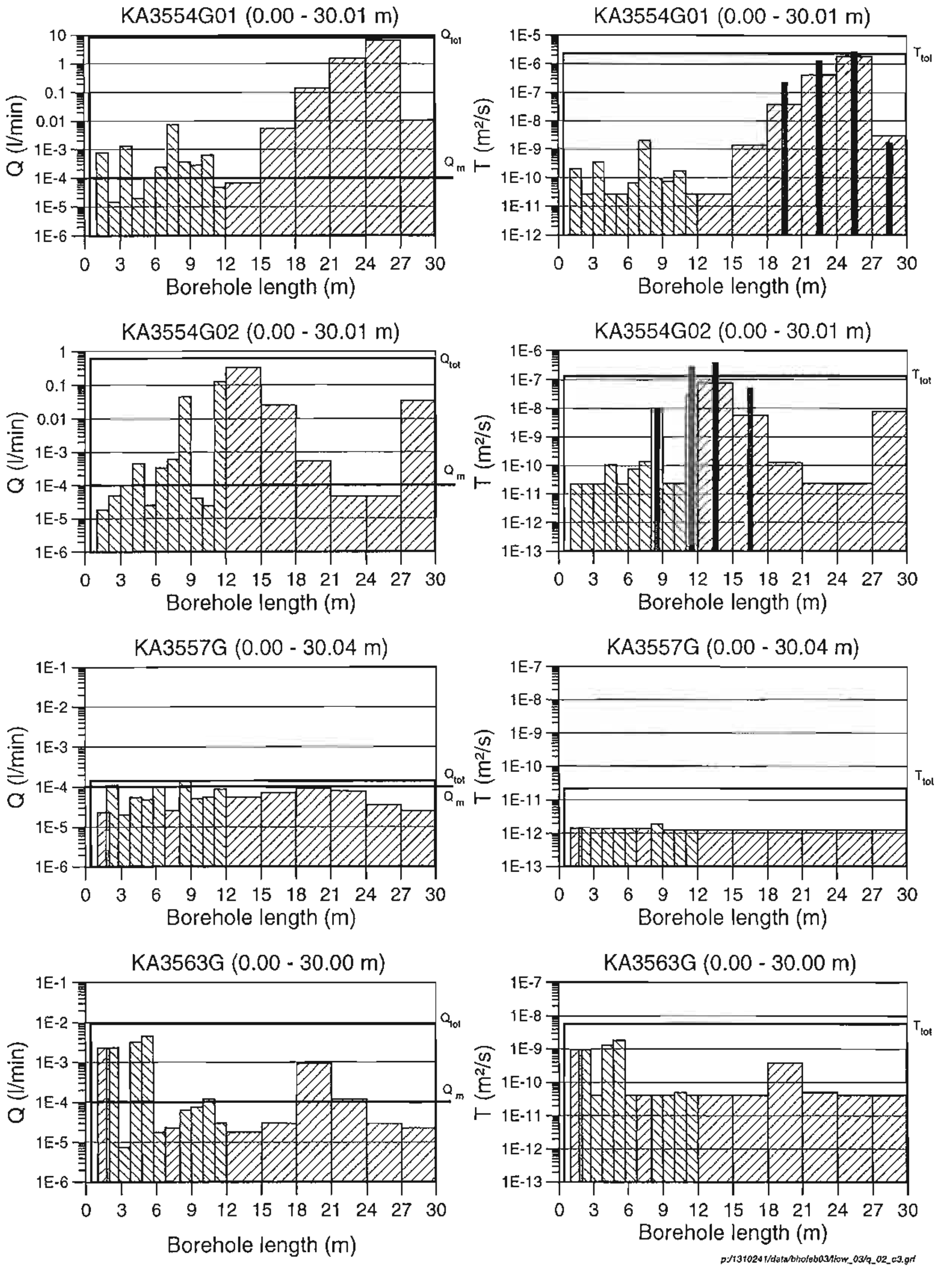


Figure 5-6 Test results of KA3554G01, KA3554G02, KA3557G and KA3563G. Q_m = estimated meas. Limit, Q_{TOT} = measurement of entire bore hole, T_{TOT} = estimated transmissivity of entire bore hole.

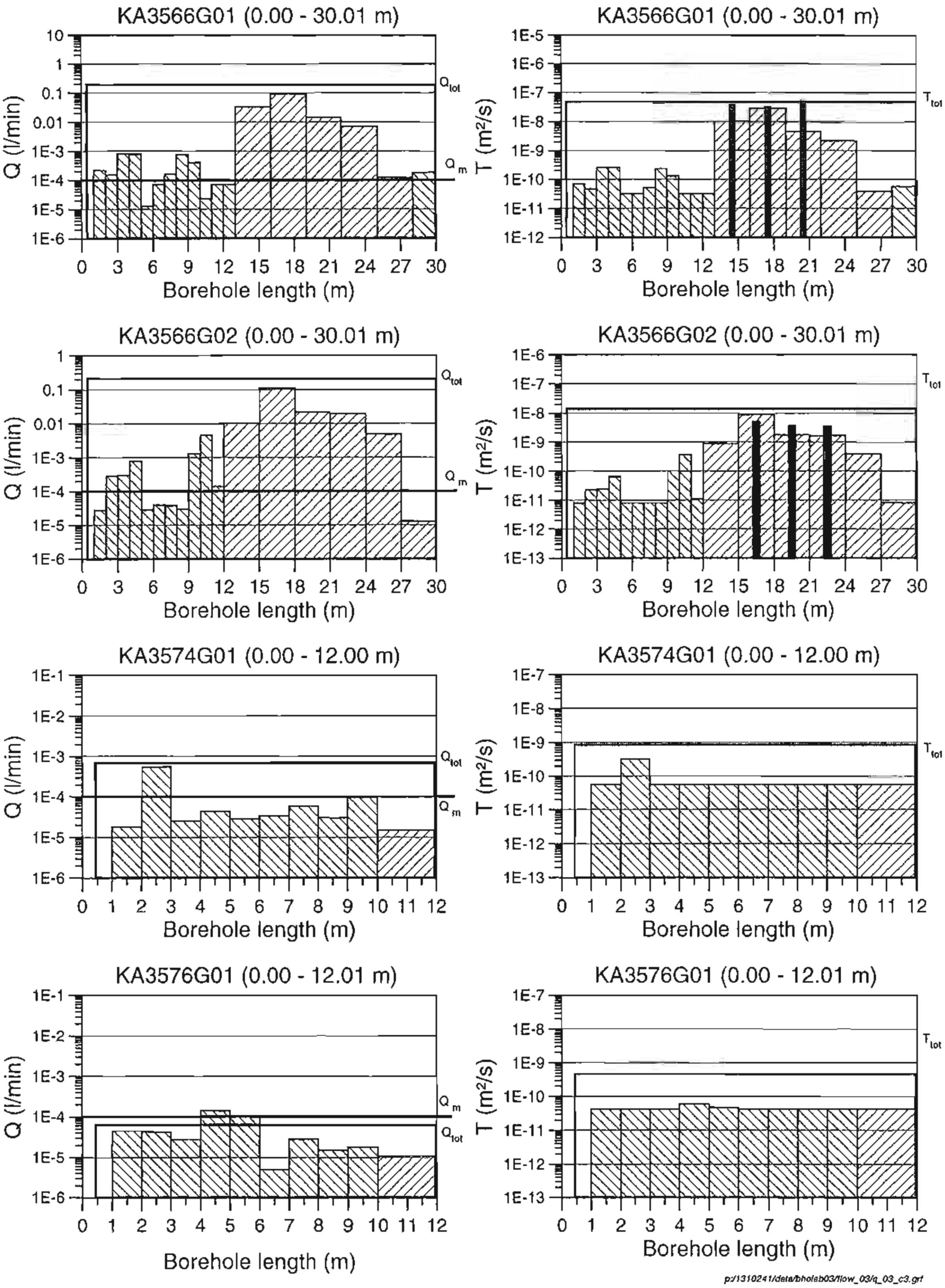


Figure 5-7 Test results of KA3566G01, KA3566G02, KA3574G01 and KA3576G01. Q_m = estimated meas. Limit, Q_{TOT} = measurement of entire bore hole, T_{TOT} = estimated transmissivity of entire bore hole.

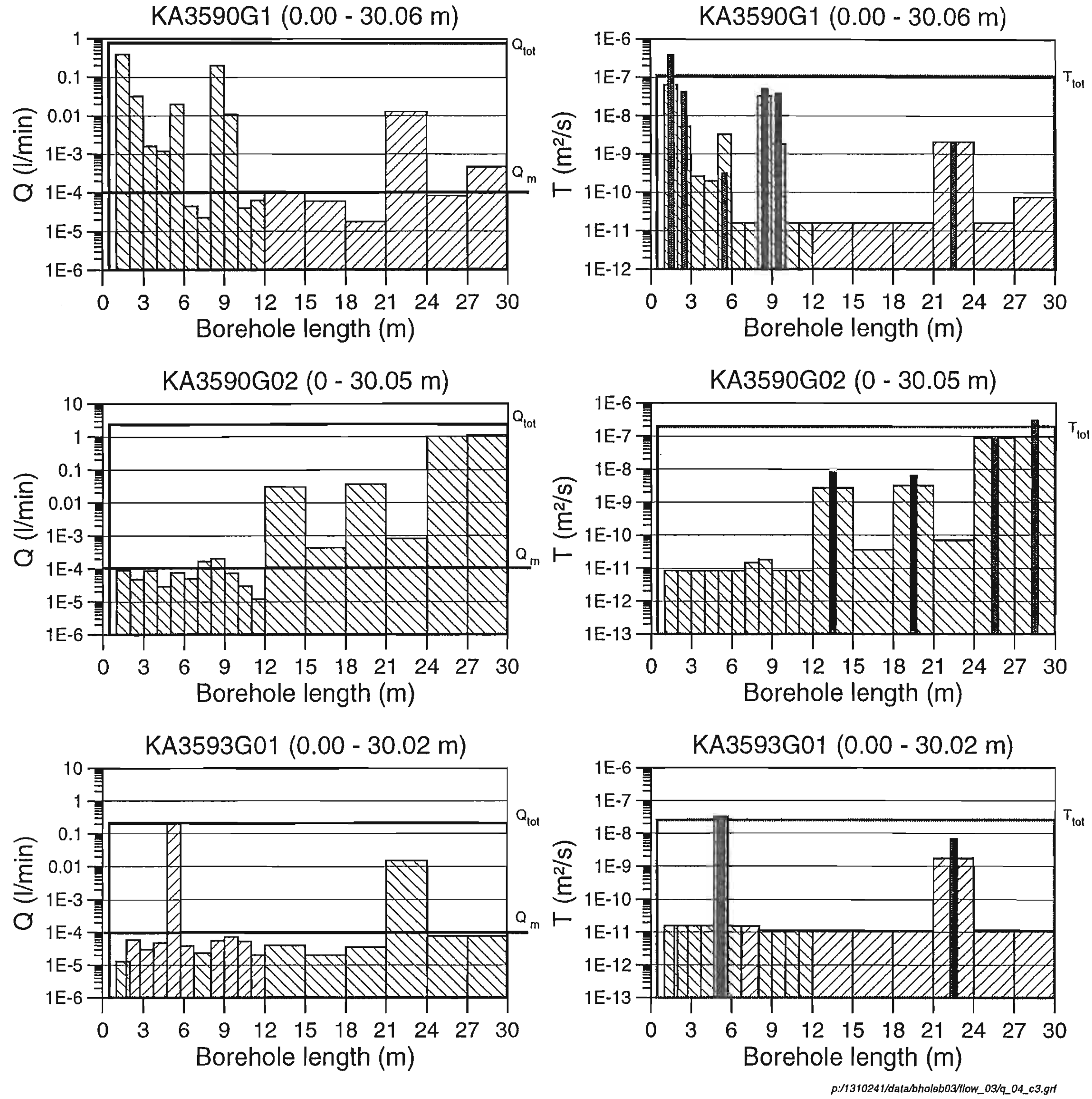


Figure 5-8 Test results of KA3590G01, KA3590G02, and KA3593G01. Q_m = estimated meas. Limit, Q_{TOT} = measurement of entire bore hole, T_{TOT} = estimated transmissivity of entire bore hole.

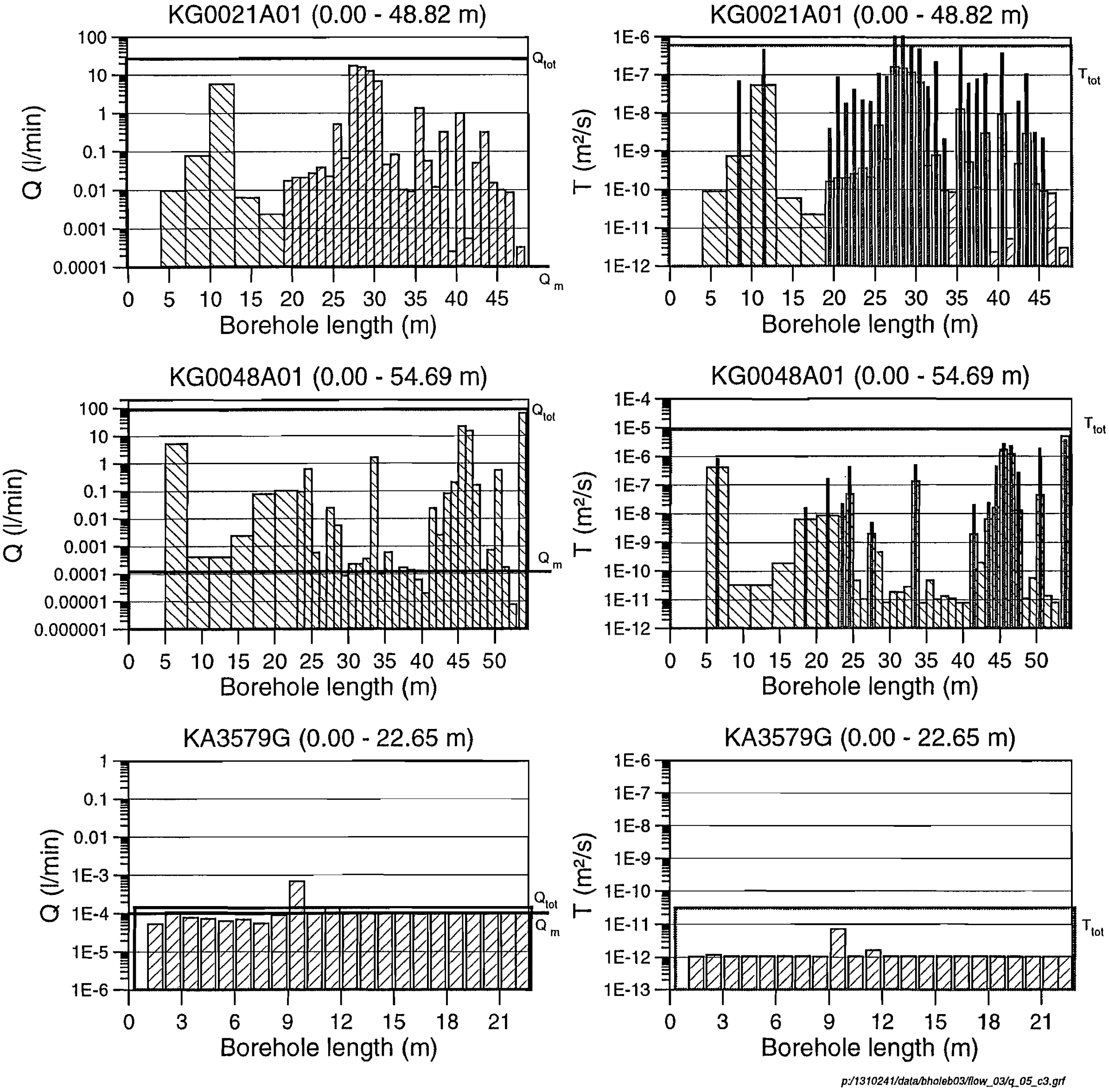


Figure 5-9 Test results of KG0021A01, KG0048A01 and KA3579G. Qm = estimated meas. Limit, Q_{TOT} = measurement of entire bore hole, T_{TOT} = estimated transmissivity of entire bore hole.

Table 5-8 Results from flowlogging in boreholes KA3539G, KA3542G01 and KA3542G02.

Borehole	SECUP	SECLOW	Q	T
	(m)	(m)	(l/min)	(m^2/s)
KA3539G	1.0	2.0	1.30E-03	4.2E-10
KA3539G	1.7	2.7	4.80E-05	3.2E-11
KA3539G	2.7	3.7	4.80E-05	3.2E-11
KA3539G	3.7	4.7	9.50E-04	3.1E-10
KA3539G	4.7	5.7	5.50E-03	1.8E-09
KA3539G	5.7	6.7	0.0825	2.7E-08
KA3539G	6.7	8.0	0.058	1.9E-08
KA3539G	8.0	9.0	1.50E-05	1.4E-11
KA3539G	9.0	10.0	2.30E-05	1.4E-11
KA3539G	10.0	11.0	3.30E-05	1.4E-11
KA3539G	11.0	12.0	8.80E-02	1.2E-08
KA3539G	12.0	15.0	3.50E-02	4.9E-09
KA3539G	15.0	18.0	4.06E+00	5.7E-07
KA3539G	18.0	21.0	4.90E-02	6.9E-09
KA3539G	21.0	24.0	2.60E-02	3.7E-09
KA3539G	24.0	27.0	1.20E-04	1.7E-11
KA3539G	27.0	30.0	2.30E-05	1.4E-11
KA3542G01	1.0	2.0	5.00E-06	9.3E-12
KA3542G01	2.0	3.0	4.50E-05	9.3E-12
KA3542G01	3.0	4.0	8.10E-05	9.3E-12
KA3542G01	4.0	5.0	1.00E-03	9.3E-11
KA3542G01	5.0	6.0	1.00E-05	9.3E-12
KA3542G01	6.0	7.0	1.00E-05	9.3E-12
KA3542G01	7.0	8.0	5.00E-06	9.3E-12
KA3542G01	8.0	9.0	2.50E-05	9.3E-12
KA3542G01	9.0	10.0	1.50E-05	9.3E-12
KA3542G01	10.0	11.0	1.30E-05	9.3E-12
KA3542G01	11.0	12.0	8.90E-04	8.3E-11
KA3542G01	12.0	15.0	4.40E-02	4.1E-09
KA3542G01	15.0	18.0	5.39E-01	5.0E-08
KA3542G01	18.0	21.0	1.24E+00	1.2E-07
KA3542G01	21.0	24.0	1.20E+00	1.1E-07
KA3542G01	24.0	27.0	4.30E-05	9.3E-12
KA3542G01	27.0	30.0	4.07E-01	3.8E-08
KA3542G02	1.0	2.0	2.00E-04	3.2E-11
KA3542G02	2.0	3.0	6.60E-04	1.0E-10
KA3542G02	3.0	4.0	1.27E-01	2.0E-08
KA3542G02	4.0	5.0	1.20E-01	1.9E-08
KA3542G02	5.0	6.0	2.54E+00	4.0E-07
KA3542G02	6.0	7.0	5.10E-04	8.1E-11
KA3542G02	7.0	8.0	3.80E-05	1.6E-11
KA3542G02	8.0	9.0	6.10E-05	1.6E-11
KA3542G02	9.0	10.0	3.80E-04	6.0E-11
KA3542G02	10.0	11.0	5.20E-02	8.3E-09
KA3542G02	11.0	12.0	9.00E-02	1.4E-08
KA3542G02	12.0	15.0	2.10E-02	3.3E-09
KA3542G02	15.0	18.0	8.00E-02	1.3E-08
KA3542G02	18.0	21.0	3.60E-02	5.7E-09
KA3542G02	21.0	24.0	7.60E-04	1.2E-10
KA3542G02	24.0	27.0	1.45E-02	2.3E-09
KA3542G02	27.0	30.0	5.70E-03	9.1E-10

Table 5-9 Results from flowlogging in boreholes KA3548A01, KA3554G01 and KA3554G02.

Borehole	SECUP	SECLOW	Q	T
	(m)	(m)	(l/min)	(m^2/s)
KA3548A01	3.0	4.0	3.40E-03	5.8E-10
KA3548A01	4.0	5.0	6.50E-05	1.7E-11
KA3548A01	5.0	6.0	1.26E-01	2.2E-08
KA3548A01	6.0	7.0	2.70E-02	4.6E-09
KA3548A01	7.0	8.0	1.30E-03	2.2E-10
KA3548A01	8.0	9.0	1.10E-03	1.9E-10
KA3548A01	9.0	10.0	1.85E+00	3.2E-07
KA3548A01	10.0	11.0	1.00E-07	1.7E-11
KA3548A01	11.0	12.0	1.10E-04	1.9E-11
KA3548A01	12.0	15.0	5.30E-02	9.1E-09
KA3548A01	15.0	18.0	2.12E-01	3.6E-08
KA3548A01	18.0	21.0	3.40E+00	5.8E-07
KA3548A01	21.0	24.0	1.16E-01	2.0E-08
KA3548A01	24.0	27.0	1.70E-02	2.9E-09
KA3548A01	27.0	30.0	4.80E-02	8.2E-09
KA3554G01	1.0	2.0	7.60E-04	2.1E-10
KA3554G01	2.0	3.0	1.50E-05	2.7E-11
KA3554G01	3.0	4.0	1.30E-03	3.5E-10
KA3554G01	4.0	5.0	2.00E-05	2.7E-11
KA3554G01	5.0	6.0	9.80E-05	2.7E-11
KA3554G01	6.0	7.0	2.40E-04	6.5E-11
KA3554G01	7.0	8.0	7.40E-03	2.0E-09
KA3554G01	8.0	9.0	3.60E-04	9.7E-11
KA3554G01	9.0	10.0	2.80E-04	7.6E-11
KA3554G01	10.0	11.0	6.40E-04	1.7E-10
KA3554G01	11.0	12.0	4.80E-05	2.7E-11
KA3554G01	12.0	15.0	6.60E-05	2.7E-11
KA3554G01	15.0	18.0	5.30E-03	1.4E-09
KA3554G01	18.0	21.0	1.41E-01	3.8E-08
KA3554G01	21.0	24.0	1.54E+00	4.2E-07
KA3554G01	24.0	27.0	6.80E+00	1.8E-06
KA3554G01	27.0	30.0	1.10E-02	3.0E-09
KA3554G02	1.0	2.0	1.80E-05	2.3E-11
KA3554G02	2.0	3.0	4.80E-05	2.3E-11
KA3554G02	3.0	4.0	1.00E-04	2.3E-11
KA3554G02	4.0	5.0	4.60E-04	1.0E-10
KA3554G02	5.0	6.0	2.50E-05	2.3E-11
KA3554G02	6.0	7.0	3.30E-04	7.5E-11
KA3554G02	7.0	8.0	6.00E-04	1.4E-10
KA3554G02	8.0	9.0	4.50E-02	1.0E-08
KA3554G02	9.0	10.0	4.00E-05	2.3E-11
KA3554G02	10.0	11.0	2.30E-05	2.3E-11
KA3554G02	11.0	12.0	1.28E-01	2.9E-08
KA3554G02	12.0	15.0	3.34E-01	7.6E-08
KA3554G02	15.0	18.0	2.50E-02	5.7E-09
KA3554G02	18.0	21.0	5.40E-04	1.2E-10
KA3554G02	21.0	24.0	4.50E-05	2.3E-11
KA3554G02	24.0	27.0	4.50E-05	2.3E-11
KA3554G02	27.0	30.0	3.50E-02	8.0E-09

Table 5-10 Results from flowlogging in boreholes KA3557G, KA3563G and KA3566G01.

Borehole	SECUP	SECLOW	Q	T
	(m)	(m)	(l/min)	(m^2/s)
KA3557G	1.0	2.0	2.30E-05	1.4E-12
KA3557G	1.7	2.7	1.10E-04	1.5E-12
KA3557G	2.7	3.7	2.00E-05	1.4E-12
KA3557G	3.7	4.7	5.50E-05	1.4E-12
KA3557G	4.7	5.7	4.80E-05	1.4E-12
KA3557G	5.7	6.7	1.00E-04	1.4E-12
KA3557G	6.7	8.0	2.50E-05	1.4E-12
KA3557G	8.0	9.0	1.50E-04	1.9E-12
KA3557G	9.0	10.0	5.00E-05	1.3E-12
KA3557G	10.0	11.0	5.50E-05	1.3E-12
KA3557G	11.0	12.0	8.60E-05	1.3E-12
KA3557G	12.0	15.0	5.50E-05	1.3E-12
KA3557G	15.0	18.0	7.10E-05	1.3E-12
KA3557G	18.0	21.0	9.10E-05	1.3E-12
KA3557G	21.0	24.0	7.80E-05	1.3E-12
KA3557G	24.0	27.0	3.50E-05	1.3E-12
KA3557G	27.0	30.0	2.50E-05	1.3E-12
KA3563G	1.0	2.0	2.30E-03	9.4E-10
KA3563G	1.7	2.7	2.30E-03	9.4E-10
KA3563G	2.7	3.7	7.50E-06	4.1E-11
KA3563G	3.7	4.7	3.20E-03	1.3E-09
KA3563G	4.7	5.7	4.50E-03	1.8E-09
KA3563G	5.7	6.7	1.80E-05	4.1E-11
KA3563G	6.7	8.0	2.30E-05	4.1E-11
KA3563G	8.0	9.0	6.40E-05	4.1E-11
KA3563G	9.0	10.0	7.60E-05	4.1E-11
KA3563G	10.0	11.0	1.20E-04	4.9E-11
KA3563G	11.0	12.0	3.00E-05	4.1E-11
KA3563G	12.0	15.0	1.80E-05	4.1E-11
KA3563G	15.0	18.0	3.00E-05	4.1E-11
KA3563G	18.0	21.0	9.40E-04	3.8E-10
KA3563G	21.0	24.0	1.20E-04	4.9E-11
KA3563G	24.0	27.0	3.00E-05	4.1E-11
KA3563G	27.0	30.0	2.30E-05	4.1E-11
KA3566G01	1.0	2.0	2.20E-04	6.9E-11
KA3566G01	2.0	3.0	1.50E-04	4.7E-11
KA3566G01	3.0	4.0	8.40E-04	2.6E-10
KA3566G01	4.0	5.0	8.20E-04	2.6E-10
KA3566G01	5.0	6.0	1.30E-05	3.2E-11
KA3566G01	6.0	7.0	7.10E-05	3.2E-11
KA3566G01	7.0	8.0	1.60E-04	5.0E-11
KA3566G01	8.0	9.0	7.60E-04	2.4E-10
KA3566G01	9.0	10.0	4.10E-04	1.3E-10
KA3566G01	10.0	11.0	2.30E-05	3.2E-11
KA3566G01	11.0	12.0	7.10E-05	3.2E-11
KA3566G01	12.0	13.0	7.30E-05	3.2E-11
KA3566G01	13.0	16.0	3.25E-02	1.0E-08
KA3566G01	16.0	19.0	9.10E-02	2.9E-08
KA3566G01	19.0	22.0	1.45E-02	4.6E-09
KA3566G01	22.0	25.0	7.00E-03	2.2E-09
KA3566G01	25.0	28.0	1.20E-04	3.8E-11
KA3566G01	28.0	30.0	1.80E-04	5.7E-11

Table 5-11 Results from flowlogging in boreholes KA3566G02, KA3574G01 and KA3576G01.

Borehole	SECUP	SECLOW	Q	T
	(m)	(m)	(l/min)	(m^2/s)
KA3566G02	1.0	2.0	2.80E-05	8.0E-12
KA3566G02	2.0	3.0	2.80E-04	2.2E-11
KA3566G02	3.0	4.0	3.00E-04	2.4E-11
KA3566G02	4.0	5.0	8.00E-04	6.4E-11
KA3566G02	5.0	6.0	2.80E-05	8.0E-12
KA3566G02	6.0	7.0	4.00E-05	8.0E-12
KA3566G02	7.0	8.0	3.80E-05	8.0E-12
KA3566G02	8.0	9.0	3.00E-05	8.0E-12
KA3566G02	9.0	10.0	1.30E-03	1.0E-10
KA3566G02	10.0	11.0	4.60E-03	3.7E-10
KA3566G02	11.0	12.0	1.40E-04	1.1E-11
KA3566G02	12.0	15.0	1.06E-02	8.5E-10
KA3566G02	15.0	18.0	1.09E-01	8.7E-09
KA3566G02	18.0	21.0	2.20E-02	1.8E-09
KA3566G02	21.0	24.0	2.00E-02	1.6E-09
KA3566G02	24.0	27.0	4.80E-03	3.9E-10
KA3566G02	27.0	30.0	1.30E-05	8.0E-12
KA3574G01	1.0	2.0	1.80E-05	5.7E-11
KA3574G01	2.0	3.0	5.60E-04	3.2E-10
KA3574G01	3.0	4.0	2.50E-05	5.7E-11
KA3574G01	4.0	5.0	4.30E-05	5.7E-11
KA3574G01	5.0	6.0	2.80E-05	5.7E-11
KA3574G01	6.0	7.0	3.30E-05	5.7E-11
KA3574G01	7.0	8.0	5.80E-05	5.7E-11
KA3574G01	8.0	9.0	3.00E-05	5.7E-11
KA3574G01	9.0	10.0	9.30E-05	5.7E-11
KA3574G01	10.0	12.0	1.50E-05	5.7E-11
KA3576G01	1.0	2.0	4.50E-05	4.3E-11
KA3576G01	2.0	3.0	4.30E-05	4.3E-11
KA3576G01	3.0	4.0	2.80E-05	4.3E-11
KA3576G01	4.0	5.0	1.40E-04	6.0E-11
KA3576G01	5.0	6.0	1.10E-04	4.7E-11
KA3576G01	6.0	7.0	5.00E-06	4.3E-11
KA3576G01	7.0	8.0	2.80E-05	4.3E-11
KA3576G01	8.0	9.0	1.50E-05	4.3E-11
KA3576G01	9.0	10.0	1.80E-05	4.3E-11
KA3576G01	10.0	12.0	1.10E-05	4.3E-11

Table 5-12 Results from flowlogging in boreholes KA3590G01, KA3590G02 and KA3593G.

Borehole	SECUP	SECLOW	Q	T
	(m)	(m)	(l/min)	(m^2/s)
KA3590G01	1.0	2.0	3.94E-01	6.4E-08
KA3590G01	2.0	3.0	3.20E-02	5.2E-09
KA3590G01	3.0	4.0	1.60E-03	2.6E-10
KA3590G01	4.0	5.0	1.20E-03	2.0E-10
KA3590G01	5.0	6.0	2.00E-02	3.3E-09
KA3590G01	6.0	7.0	4.50E-05	1.6E-11
KA3590G01	7.0	8.0	2.30E-05	1.6E-11
KA3590G01	8.0	9.0	2.02E-01	3.3E-08
KA3590G01	9.0	10.0	1.10E-02	1.8E-09
KA3590G01	10.0	11.0	4.00E-05	1.6E-11
KA3590G01	11.0	12.0	6.30E-05	1.6E-11
KA3590G01	12.0	15.0	1.00E-04	1.6E-11
KA3590G01	15.0	18.0	6.10E-05	1.6E-11
KA3590G01	18.0	21.0	1.80E-05	1.6E-11
KA3590G01	21.0	24.0	1.30E-02	2.1E-09
KA3590G01	24.0	27.0	8.30E-05	1.6E-11
KA3590G01	27.0	30.0	4.60E-04	7.5E-11
KA3590G02	1.0	2.0	8.80E-05	8.6E-12
KA3590G02	2.0	3.0	4.80E-05	8.6E-12
KA3590G02	3.0	4.0	8.60E-05	8.6E-12
KA3590G02	4.0	5.0	2.90E-05	8.6E-12
KA3590G02	5.0	6.0	7.60E-05	8.6E-12
KA3590G02	6.0	7.0	5.00E-05	8.6E-12
KA3590G02	7.0	8.0	1.70E-04	1.5E-11
KA3590G02	8.0	9.0	2.10E-04	1.8E-11
KA3590G02	9.0	10.0	7.30E-05	8.6E-12
KA3590G02	10.0	11.0	3.00E-05	8.6E-12
KA3590G02	11.0	12.0	1.20E-05	8.6E-12
KA3590G02	12.0	15.0	3.10E-02	2.7E-09
KA3590G02	15.0	18.0	4.30E-04	3.7E-11
KA3590G02	18.0	21.0	3.70E-02	3.2E-09
KA3590G02	21.0	24.0	8.10E-04	6.9E-11
KA3590G02	24.0	27.0	1.03E+00	8.8E-08
KA3590G02	27.0	30.0	1.12E+00	9.6E-08
KA3593G	1.0	2.0	1.30E-05	1.6E-11
KA3593G	1.7	2.7	5.80E-05	1.6E-11
KA3593G	2.7	3.7	3.00E-05	1.6E-11
KA3593G	3.7	4.7	4.80E-05	1.6E-11
KA3593G	4.7	5.7	0.204	3.2E-08
KA3593G	5.7	6.7	3.80E-05	1.6E-11
KA3593G	6.7	8.0	2.30E-05	1.6E-11
KA3593G	8.0	9.0	5.50E-05	1.1E-11
KA3593G	9.0	10.0	7.10E-05	1.1E-11
KA3593G	10.0	11.0	5.30E-05	1.1E-11
KA3593G	11.0	12.0	2.00E-05	1.1E-11
KA3593G	12.0	15.0	4.00E-05	1.1E-11
KA3593G	15.0	18.0	2.00E-05	1.1E-11
KA3593G	18.0	21.0	3.50E-05	1.1E-11
KA3593G	21.0	24.0	1.50E-02	1.7E-09
KA3593G	24.0	27.0	7.60E-05	1.1E-11
KA3593G	27.0	30.0	7.60E-05	1.1E-11

Table 5-13 Results from flow logging in bore hole KG0021A01.

Borehole	SECUP	SECLOW	Q	T
	(m)	(m)	(l/min)	(m2/s)
KG0021A01	4.0	7.0	9.60E-03	9.1E-11
KG0021A01	7.0	10.0	7.80E-02	7.4E-10
KG0021A01	10.0	13.0	5.9	5.6E-08
KG0021A01	13.0	16.0	0.0064	6.1E-11
KG0021A01	16.0	19.0	2.40E-03	2.3E-11
KG0021A01	19.0	20.0	1.70E-02	1.6E-10
KG0021A01	20.0	21.0	2.10E-02	2.0E-10
KG0021A01	21.0	22.0	2.10E-02	2.0E-10
KG0021A01	22.0	23.0	2.70E-02	2.6E-10
KG0021A01	23.0	24.0	3.80E-02	3.6E-10
KG0021A01	24.0	25.0	2.20E-02	2.1E-10
KG0021A01	25.0	26.0	5.13E-01	4.9E-09
KG0021A01	26.0	27.0	6.60E-02	6.2E-10
KG0021A01	27.0	28.0	1.79E+01	1.7E-07
KG0021A01	28.0	29.0	1.64E+01	1.6E-07
KG0021A01	29.0	30.0	1.29E+01	1.2E-07
KG0021A01	30.0	31.0	6.9	6.5E-08
KG0021A01	31.0	32.0	0.044	4.2E-10
KG0021A01	32.0	33.0	8.20E-02	7.8E-10
KG0021A01	33.0	34.0	1.00E-02	9.5E-11
KG0021A01	34.0	35.0	9.00E-03	8.5E-11
KG0021A01	35.0	36.0	6.88E-01	6.5E-09
KG0021A01	36.0	37.0	5.60E-02	5.3E-10
KG0021A01	37.0	38.0	1.20E-02	1.1E-10
KG0021A01	38.0	39.0	3.20E-01	3.0E-09
KG0021A01	39.0	40.0	2.50E-04	2.4E-12
KG0021A01	40.0	41.0	1.01E+00	9.6E-09
KG0021A01	41.0	42.0	5.50E-04	5.2E-12
KG0021A01	42.0	43.0	5.00E-02	4.7E-10
KG0021A01	43.0	44.0	3.15E-01	3.0E-09
KG0021A01	44.0	45.0	0.015	1.4E-10
KG0021A01	45.0	46.0	0.01	9.5E-11
KG0021A01	46.0	47.0	0.0085	8.0E-11
KG0021A01	47.0	48.8	0.00032	3.0E-12

Table 5-14 Results from flow logging in bore hole KG0048A01.

Borehole	SECUP	SECLOW	Q	T
	(m)	(m)	(l/min)	(m2/s)
KG0048A01	5	8	5.20E+00	4.1E-07
KG0048A01	8	11	4.20E-04	3.3E-11
KG0048A01	11	14	4.10E-04	3.2E-11
KG0048A01	14	17	2.40E-03	1.9E-10
KG0048A01	17	20	7.80E-02	6.2E-09
KG0048A01	20	23	1.06E-01	8.4E-09
KG0048A01	23	24	9.70E-02	7.7E-09
KG0048A01	24	25	6.24E-01	4.9E-08
KG0048A01	25	26	5.80E-04	4.6E-11
KG0048A01	26	27	1.30E-04	1.0E-11
KG0048A01	27	28	2.50E-02	2.0E-09
KG0048A01	28	29	5.80E-03	4.6E-10
KG0048A01	29	30	8.70E-05	7.9E-12
KG0048A01	30	31	2.30E-04	1.8E-11
KG0048A01	31	32	2.30E-04	1.8E-11
KG0048A01	32	33	3.60E-04	2.8E-11
KG0048A01	33	34	1.67E+00	1.3E-07
KG0048A01	34	35	1.00E-04	7.9E-12
KG0048A01	35	36	6.00E-04	4.7E-11
KG0048A01	36	37	1.30E-04	1.0E-11
KG0048A01	37	38	1.70E-04	1.3E-11
KG0048A01	38	39	1.40E-04	1.1E-11
KG0048A01	39	40	6.00E-05	7.9E-12
KG0048A01	40	41	2.00E-05	7.9E-12
KG0048A01	41	42	2.40E-02	1.9E-09
KG0048A01	42	43	2.50E-03	2.0E-10
KG0048A01	43	44	8.00E-02	6.3E-09
KG0048A01	44	45	2.04E-01	1.6E-08
KG0048A01	45	46	2.19E+01	1.7E-06
KG0048A01	46	47	1.50E+01	1.2E-06
KG0048A01	47	48	1.64E-01	1.3E-08
KG0048A01	48	49	1.40E-04	1.1E-11
KG0048A01	49	50	7.10E-04	5.6E-11
KG0048A01	50	51	5.61E-01	4.4E-08
KG0048A01	51	52	1.70E-04	1.3E-11
KG0048A01	52	53	7.60E-06	7.9E-12
KG0048A01	53	54.69	6.29E+01	5.0E-06

Table 5-15 Results from flow logging in bore hole KA3579G.

Borehole	SECUP	SECLOW	Q	T
	(m)	(m)	(l/min)	(m2/s)
KA3579G	1	2	5.30E-05	1.1E-12
KA3579G	2	3	1.10E-04	1.2E-12
KA3579G	3	4	7.80E-05	1.1E-12
KA3579G	4	5	7.30E-05	1.1E-12
KA3579G	5	6	6.30E-05	1.1E-12
KA3579G	6	7	7.00E-05	1.1E-12
KA3579G	7	8	5.50E-05	1.1E-12
KA3579G	8	9	9.00E-05	1.1E-12
KA3579G	9	10	6.80E-04	7.2E-12
KA3579G	10	11	9.60E-05	1.1E-12
KA3579G	11	12	1.50E-04	1.6E-12
KA3579G	12	13	1.00E-04	1.1E-12
KA3579G	13	14	1.00E-04	1.1E-12
KA3579G	14	15	1.00E-04	1.1E-12
KA3579G	15	16	1.00E-04	1.1E-12
KA3579G	16	17	1.00E-04	1.1E-12
KA3579G	17	18	1.00E-04	1.1E-12
KA3579G	18	19	1.00E-04	1.1E-12
KA3579G	19	20	1.00E-04	1.1E-12
KA3579G	20	21	1.00E-04	1.1E-12
KA3579G	21	22	1.00E-04	1.1E-12
KA3579G	22	22.65	1.00E-04	1.1E-12

5.5 Flow-logging with UCM-tool

The results of these UCM logging are presented in *Appendix 6.* In the appendix all loggings up to June 1999 are detailed.

6 COMPILATION OF RESULTS

In this chapter the statistical analysis of the results of hydraulic tests in the long exploratory boreholes, in drill campaign 3, are presented and discussed. Inflow to the tunnel is also shown as background information.

6.1 Inflow to tunnel

In *Figure 6-1* the mean values of the inflow to the tunnel is presented *(Patel et al. /1997/).* Since the tunnel inclination in this part is somewhat upwards from 3500 to 3600 m, the measured inflow rates are for the tunnel chainage for the actual weir up to the chainage for the next weir. The inflow pattern is more or less consistent with the fracture mapping of the tunnel. A higher frequency of mapped water conductive fractures corresponds to higher inflow rates at a weir downstream.

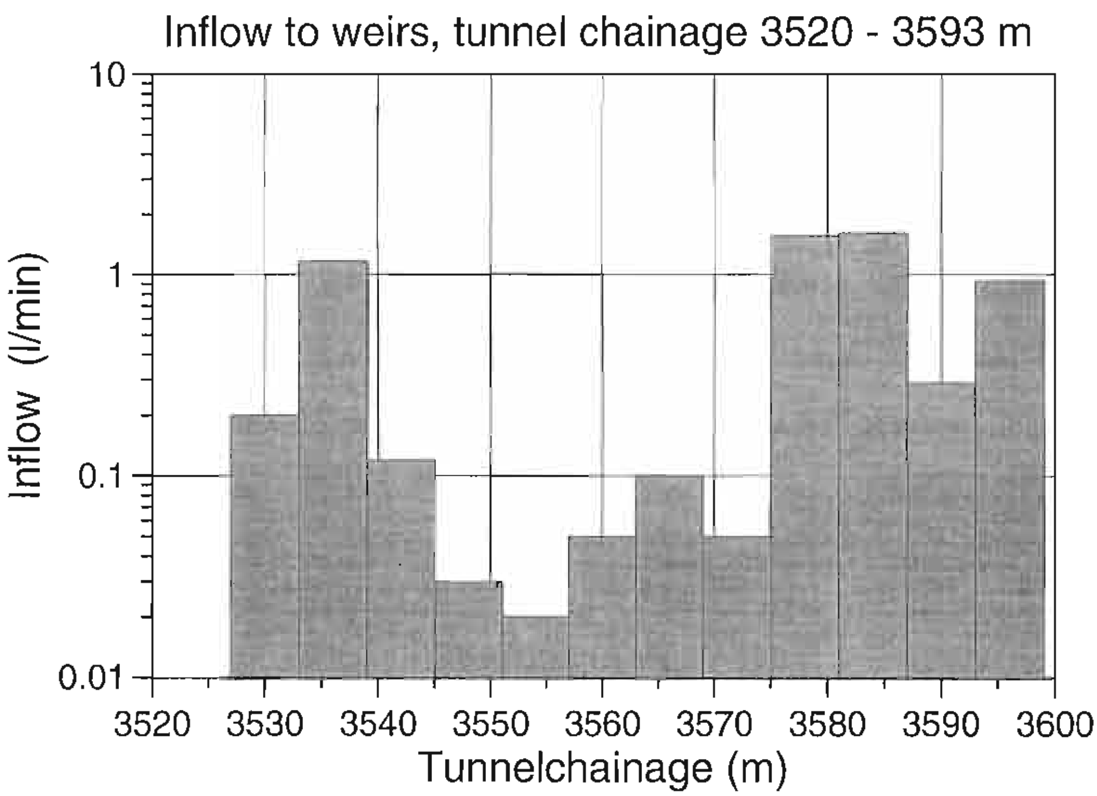


Figure 6-1 Inflow to the tunnel (from Patel et al. /1997/).

6.2 Undisturbed pressure

In Appendix 2 all estimated and measured values of the undisturbed pressure in the exploratory boreholes are detailed in diagrams.

The available boreholes drilled during the drilling campaign 3 were divided into 5 subclasses in order to see the importance of the bore hole directions :

- All boreholes
- Sub-vertical bore holes
- Sub-horizontal boreholes (KG0021A01, KG0048A01 and KA3548A01)
- Southerly inclined boreholes (KA3542G01, KA3554G01, KA3566G01 and KA3590G01)
- Northerly inclined boreholes (KA3542G02, KA3554G02, KA3566G02 and KA3590G02)

In *Figure 6-2 and Figure 6-3* the pressure, P_0, is plotted versus distance from the tunnel centre (D_t). In the figure a linear regression relationship (P_0 versus Log10(D_t)) is included for the different bore hole groups described above. The linear regression relationships are forced to $P_0 = 0$ at $D_t = 2.5$ m (tunnel wall).

It can be noted in the diagram that the sub-vertical boreholes show the lowest pressures and the horizontal boreholes the highest and the inclined have a pressure in between. This is in accordance with the concept that the sub-vertical fractures are the most conductive ones.

The equations for the different relationships (plotted lines) in Figure 6-2 are shown below

- All boreholes : $P_0 = 316.56 * \text{Log}_{10}(D_t) - 121.22$ (6-1a)
- Sub-vertical bore holes : $P_0 = 226.81 * \text{Log}_{10}(D_t) - 88.36$ (6-1b)
- Sub-horizontal bore hole (KA3548A01) : $P_0 = 404.52 * \text{Log}_{10}(D_t) - 160.72$ (6-1c)
- Southern boreholes : $P_0 = 346.80 * \text{Log}_{10}(D_t) - 136.32$ (6-1d)
- Northern boreholes : $P_0 = 314.56 * \text{Log}_{10}(D_t) - 122.54$ (6-1e)

where

D_t = the radial distance from tunnel centre (m)

P0 = the undisturbed pressure outside the prototype tunnel (m (of water))

As can be seen in *Figures 6-2 and 6-3* the spread of the measured pressure (P_0) is great and in *Figure 6-3* the prediction band indicates a probable interval for P_0.

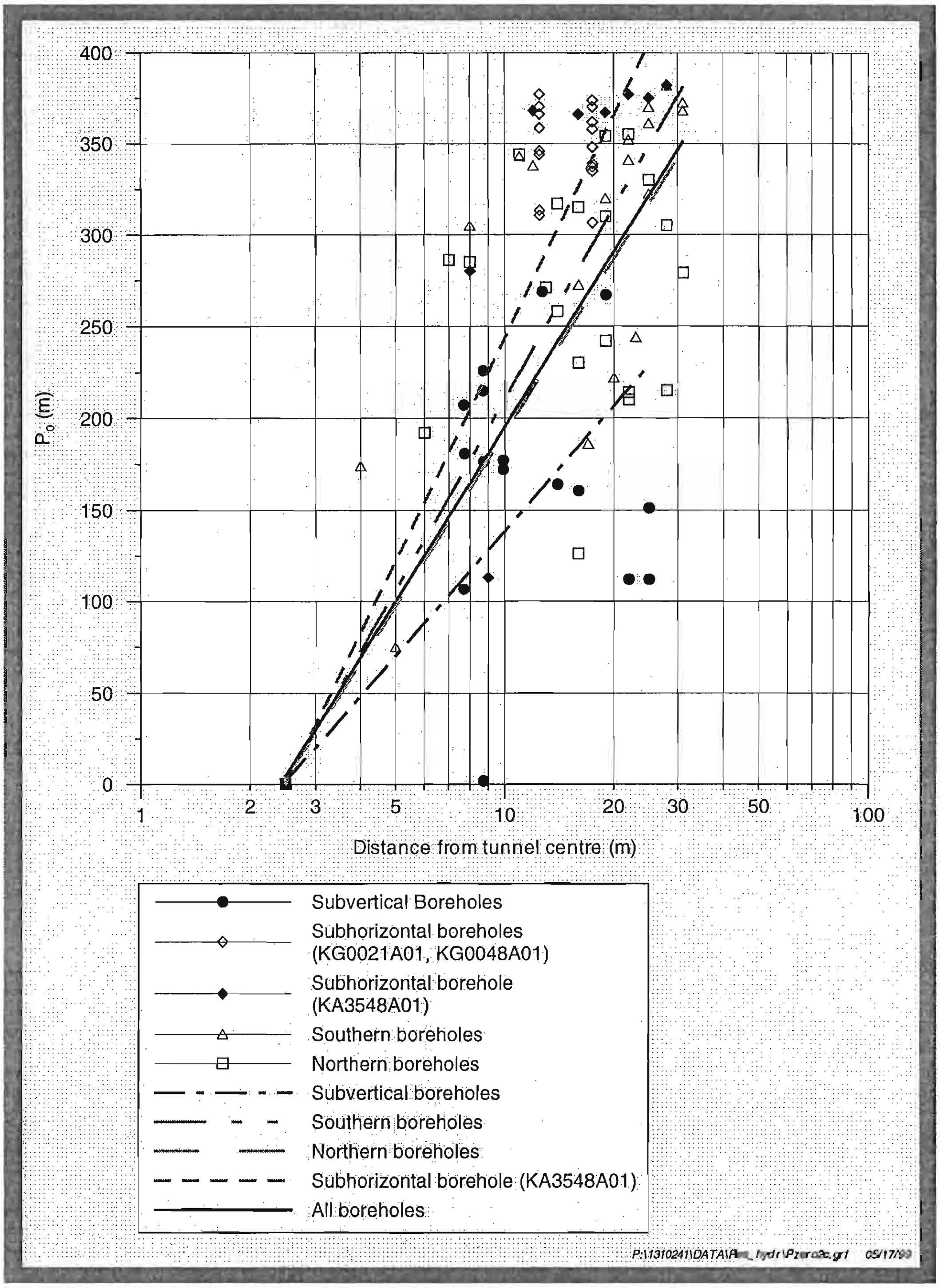


Figure 6-2 Pressure P_0 versus perpendicular distance from tunnel centre. The linear relationships are forced to $P_0 = 0$ at $D_t = 2.5$ m.

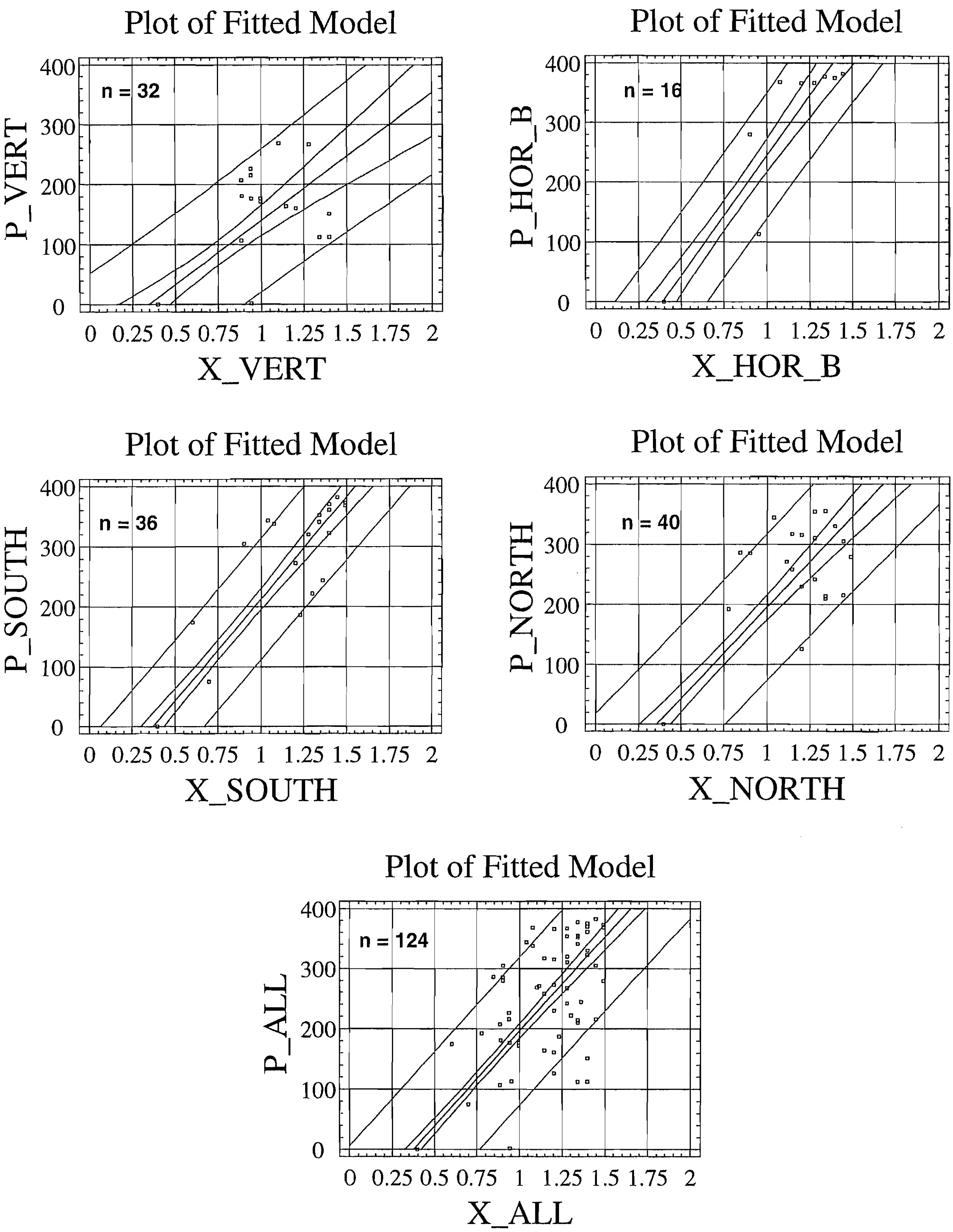


Figure 6-3 Pressure (P_0)versus distance (D_t)from tunnel centre. Log_{10} D_t on x-axis. P_0 : m of water, D_t : m. The dotted line, outermost, is the 95 % prediction band on P_0 as a function of Log_{10} D_t, while the inner line is the 95 % confidence band on mean P_0. Half the sample (n) is located at the tunnel wall.

6.3 Hydraulic conductivity around the tunnel

In order to evaluate the hydraulic conductivity in different zones around the tunnel a statistical analysis concerning hydraulic conductivity was made. All 34 boreholes drilled during drill batch 1 -3 were used for the statistical analysis. The boreholes were divided into the following subclasses:

1. All boreholes drilled during drilling campaign 1-3
2. Sub-vertical bore holes
3. Sub-horizontal boreholes (KG0021A01, KG0048A01 and KA3548A01)
4. Southerly boreholes (KA3542G01, KA3554G01, KA3566G01 and KA3590G01)
5. Northerly boreholes (KA3542G02, KA3554G02, KA3566G02 and KA3590G02)

Each of these subclasses were statistically analysed using the criteria's below

- Log_{10} K for 1 m sections (tested as such)
- Log_{10} K for 3 m sections (tested as such)
- Log_{10} K for 3 m sections, where the transmissivity of the 1 meter tested sections were added together in series of three to create artificial 3 m sections and then divided by 3 meters. In this manner Log_{10} K for the entire bore hole length was created. In *Table 6-1* the results are detailed. In *Figure 6-4* the results of the group (1*3 + 3 m) are illustrated.

Table 6-1 Statistical analysis of Log_{10} K. Scale 1 m and 3 m.

Subclass (see above)	Geometric mean (m/s) **1 m**	Standard deviation (Log10 K) **1 m**	Geometric mean (m/s) **3 m**	Standard deviation (Log10 K) **3 m**	Geometric mean (m/s) **1*3 + 3 m**	Standard deviation (Log10 K) **1*3 + 3 m**
1	$8.5 \cdot 10^{-11}$	1.48	$4.1 \cdot 10^{-10}$	1.83	$3.2 \cdot 10^{-10}$	1.76
2	$2.6 \cdot 10^{-11}$	1.09	$2.5 \cdot 10^{-11}$	1.71	$3.7 \cdot 10^{-11}$	1.47
3	$2.6 \cdot 10^{-9}$	1.91	$2.5 \cdot 10^{-9}$	1.98	$8.7 \cdot 10^{-9}$	1.70
4	$9.0 \cdot 10^{-11}$	1.08	$9.4 \cdot 10^{-10}$	1.83	$6.2 \cdot 10^{-10}$	1.62
5	$1.9 \cdot 10^{-10}$	1.26	$9.1 \cdot 10^{-10}$	1.19	$8.1 \cdot 10^{-10}$	1.28

As can be noted the horizontal bore holes show considerably higher values of hydraulic conductivity than more vertical bore holes. Observe that the tested sections for the 1 m and 3 m tests are not in the same part of the boreholes, *see Tables 5-8 to 5-15.* To a minor extent probably the data is biased as the same feature (fracture or fracture system) and may have been tested in an adjacent test section due to a local hydraulically well - interconnected fracture network or long intersections between a conductive fracture and the bore hole.

In Appendix 4 the statistical analysis results are detailed. Some distributions are approximately log-normal (generally subclasses with (1*3 + 3 m) and 3 m data sets, but some deviate rather strongly from the log-normal distribution (almost all subclasses with 1 m data sets). For the near field of the prototype tunnel the distributions based on 1*3 + 3 m tests in Table 6-1 should be used preferably.

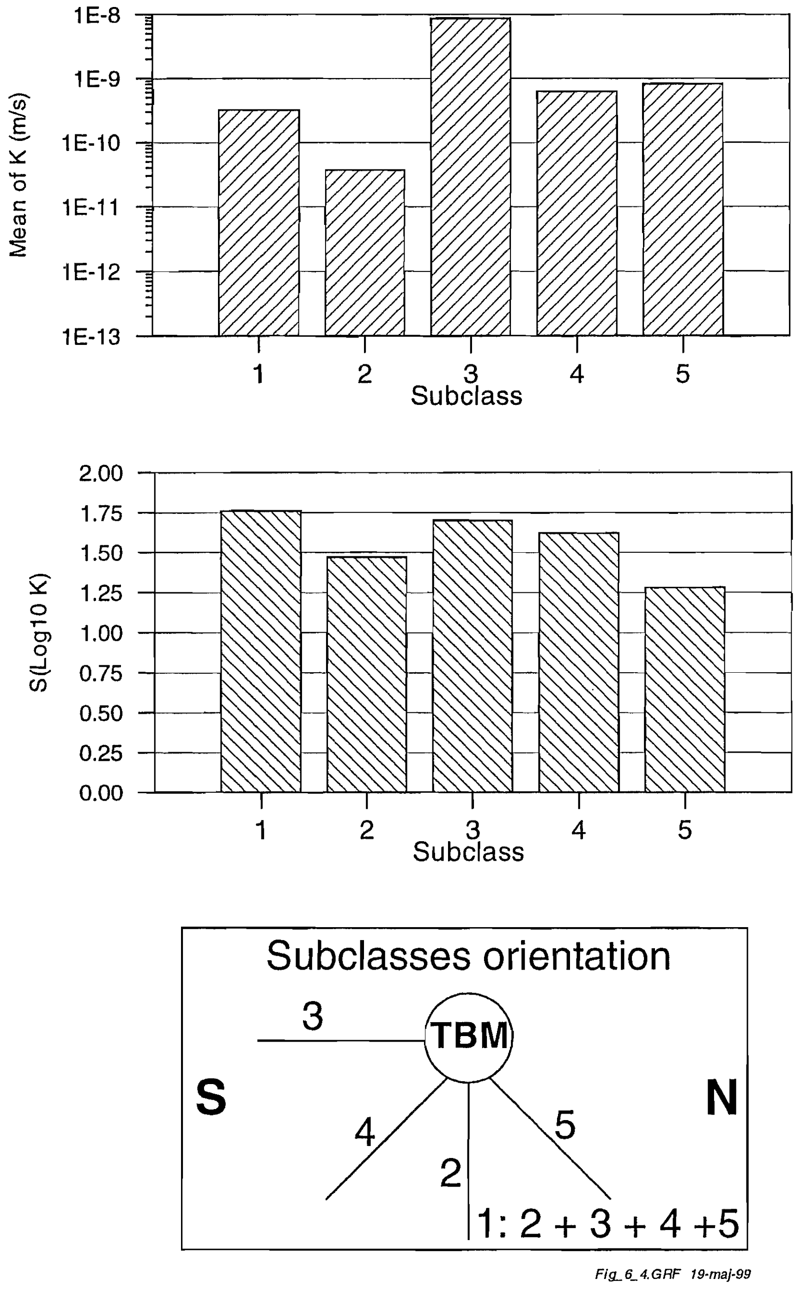


*Figure 6-4 Statistical analysis of Log10 K (1*3 + 3 m), geometric mean and standard deviation.*

In *Figures 6-5 to 6-12* Log10 K of different boreholes are shown. No symbols are shown for KA3573A and KA3600F since no hydraulic tests have been made in those boreholes. The first 50 metres of KA3510A have not been tested as well.

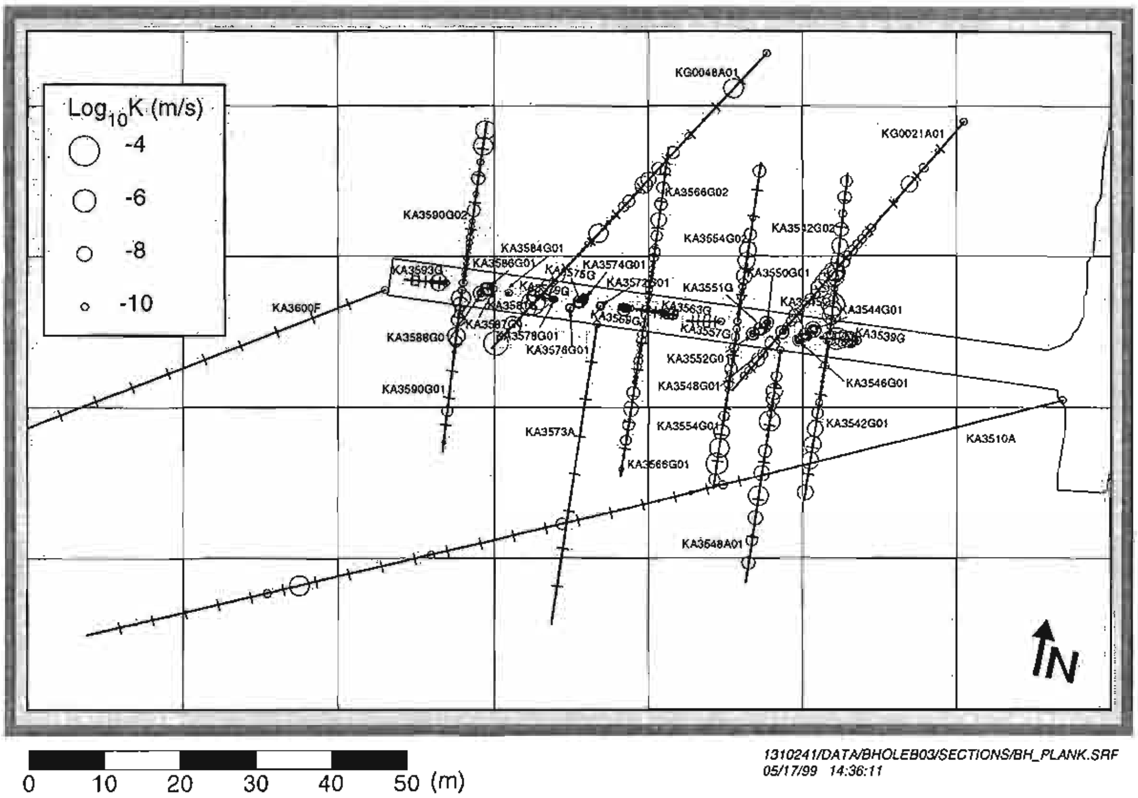


Figure 6-5 Log10 K of different boreholes around the prototype tunnel

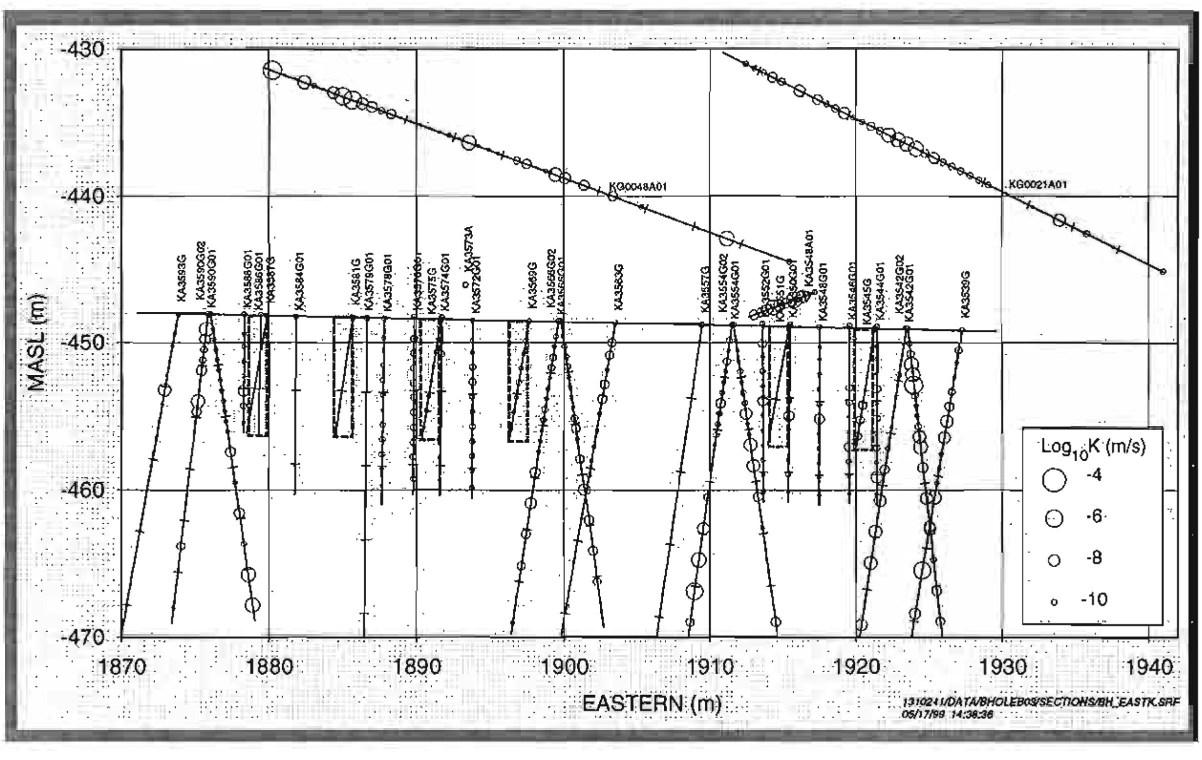


Figure 6-6 Log10 K of different boreholes around the prototype tunnel

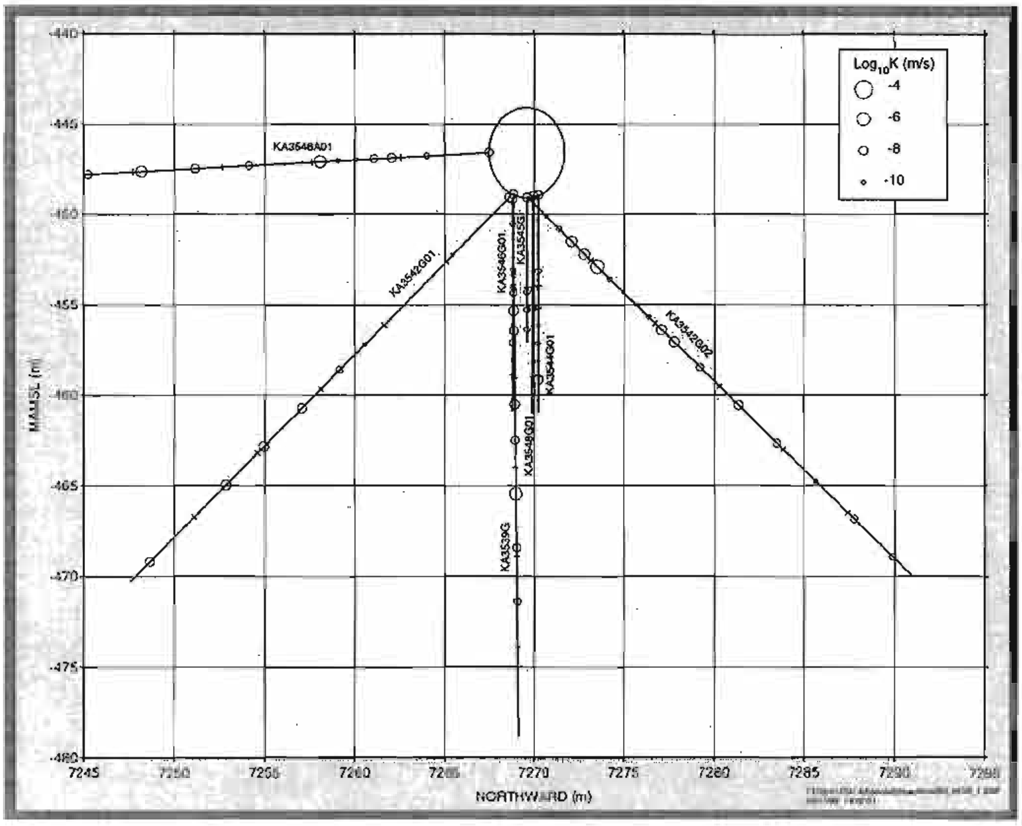


Figure 6-7 Log10 K of boreholes at chainage 3539 - 3548 m

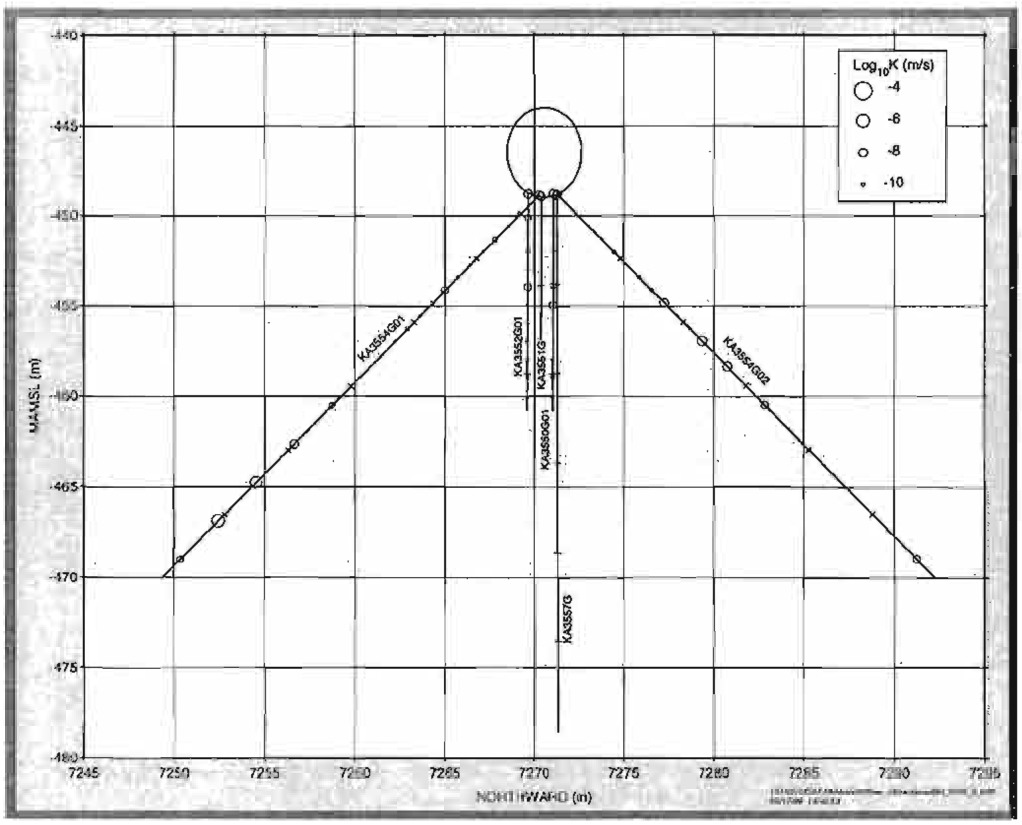


Figure 6-8 Log10 K of boreholes at chainage 3549 - 3558 m

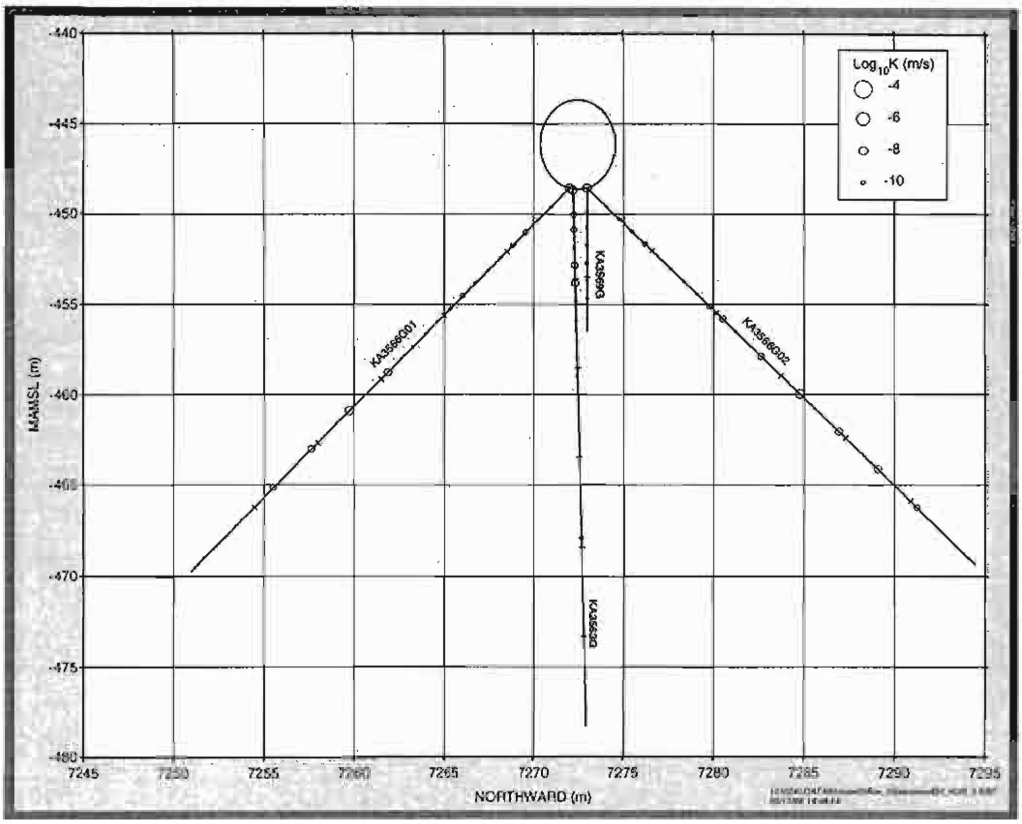


Figure 6-9 Log10 K of boreholes at chainage 3559 - 3570 m

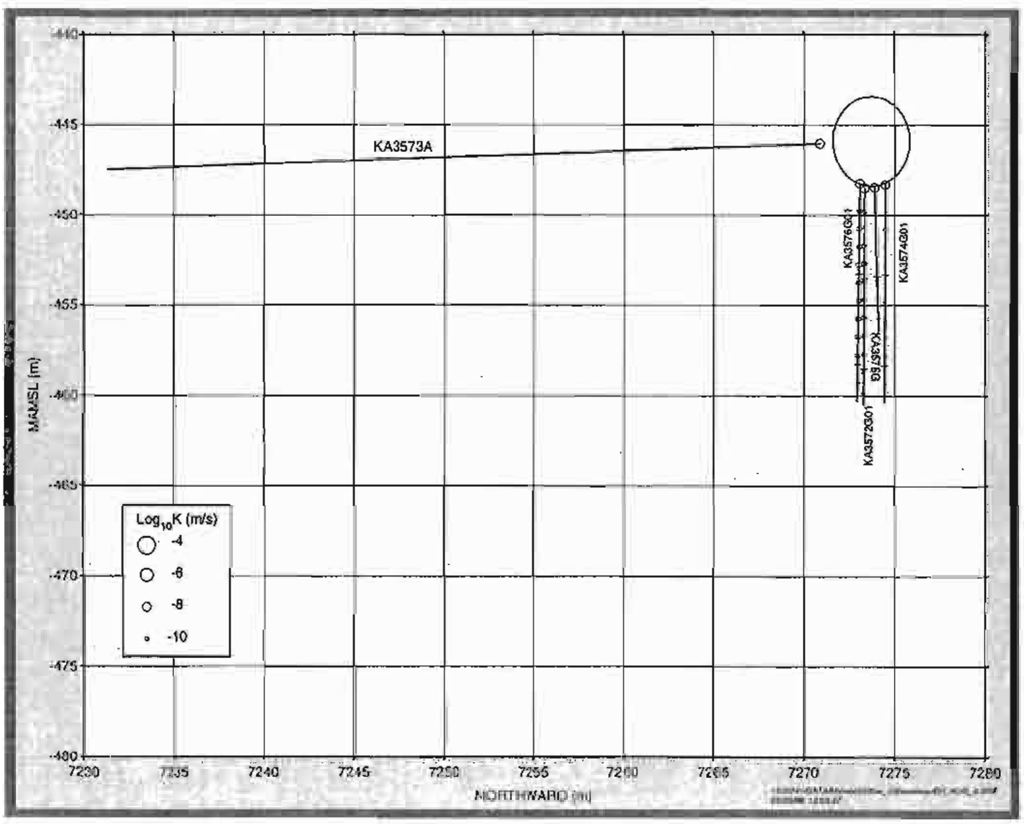


Figure 6-10 Log10 K of boreholes at chainage 3571 - 3576 m

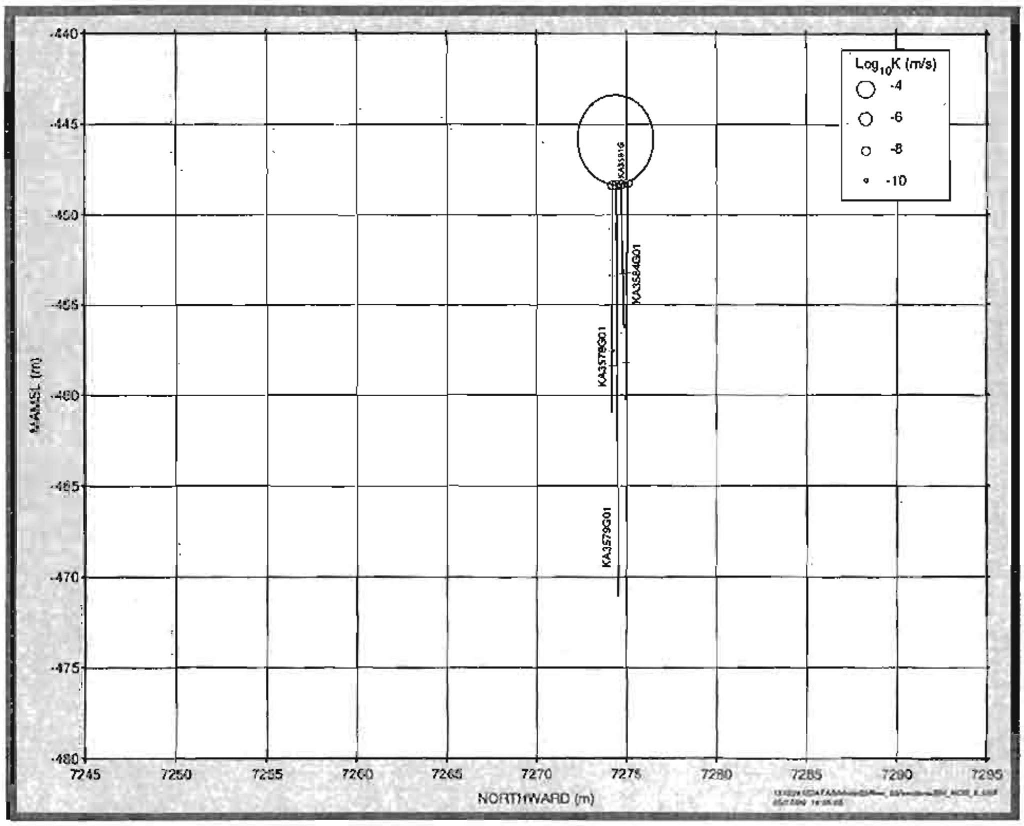


Figure 6-11 Log10 K of boreholes at chainage 3577 - 3585 m

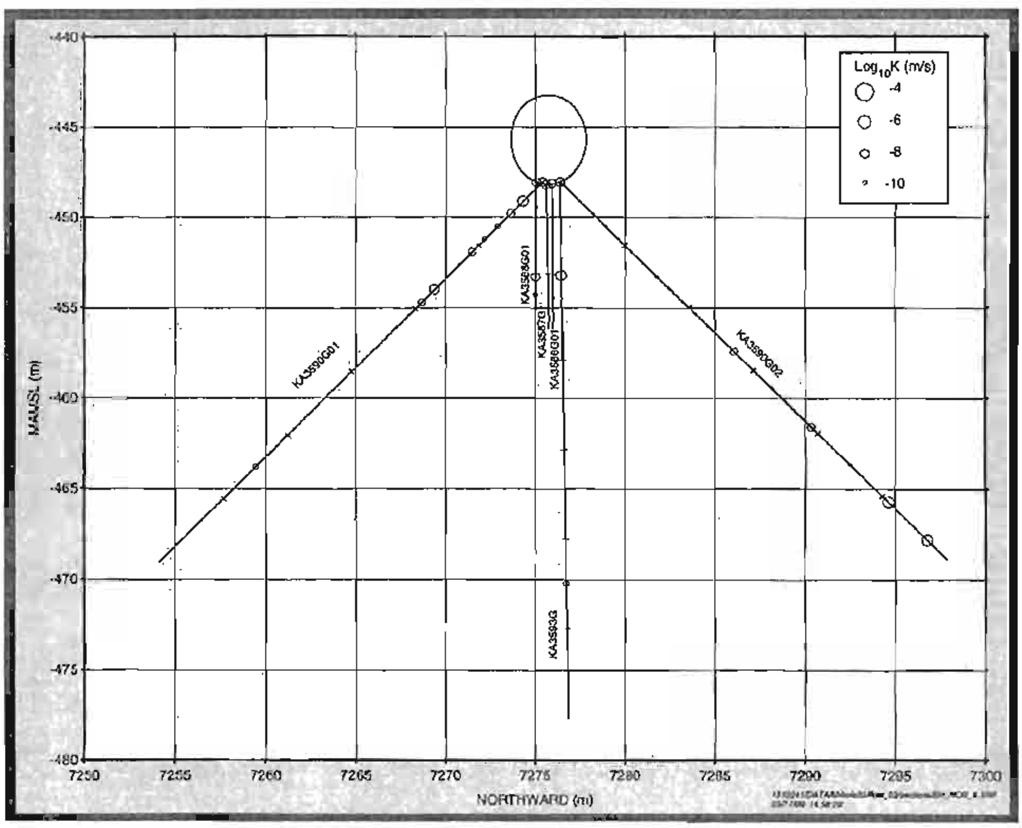


Figure 6-12 Log10 K of boreholes at chainage 3586 - 3593 m

6.4 Distance between features

In this analysis the distance between different features exceeding a predefined magnitude of transmissivity were studied. Features exceeding six different orders of magnitude of the transmissivity were analysed : T > 10^{-11}, 10^{-10}, 10^{-9}, 10^{-8}, 10^{-7} and 10^{-6} m^2/s. In this analysis all boreholes drilled during the Prototype Repository Project (drill batch 1 - 3) were used, totalling 34 bore holes. The evaluation is based on the transmissivity evaluated for the 1 m and 3 m sections assigning the midpoint of the section as a feature. The transmissivity for each section is the T_tot value in *Table 5-7* and similar results from drill batch 1 and 2. If no pressure build-up test was done in a section the transmissivity evaluated from the flow-logging, *Table 5-8 to 5-15* and similar results from drill batch 1 and 2 were used.

The statistical analysis used was method C in *Figure 6-13.* The difference between Methods A and B and Method C is that in C every available bore hole meter is used in the estimations of distance between different features. Five different data sets were created with the 34 (or fewer in subclasses) boreholes randomly ranked in a "long" bore hole. The beginning (d1) plus the end (d10) of the "long" bore hole make up one distance in the analysis according to method C.

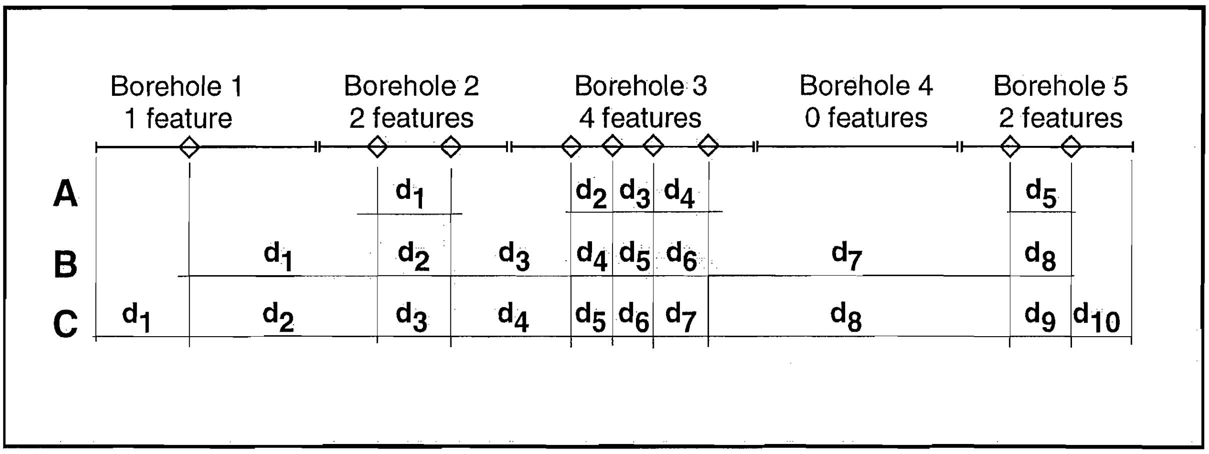


Figure 6-13 Methods for calculation of distance between features in several boreholes

The available boreholes were divided into the following subclasses and analysed:

1. All boreholes drilled during drilling campaign 1, 2 and 3 (34 boreholes)

2. Sub-vertical bore holes (23 boreholes)

3. Sub-horizontal boreholes (KG0021A01, KG0048A01 and KA3548A01)

4. Southerly inclined boreholes (KA3542G01, KA3554G01, KA3566G01 and KA3590G01)

5. Northerly inclined boreholes (KA3542G02, KA3554G02, KA3566G02 and KA3590G02)

In *Table 6-2* and *Figures 6-7 to 6-9* a summary of the results of the distance analysis are presented. In Appendix 5 the details of the analysis are presented.

As an example of a log-normal distribution of the distances, *Figure 6-14* is presented which shows the log normal probability plot for distances between features with a transmissivity greater than $1 \cdot 10^{-9}$ m^2/s for data set 1. In Appendix 5 all plots for data set 1 are shown. The distances between the features are approximately log-normal distributed in several cases, see Appendix 5.

In tables 6-3 to 6-5 the maximum and minimum values from the data sets 1 - 5 of Dmedian, Dg and S(Log10 D) are shown.

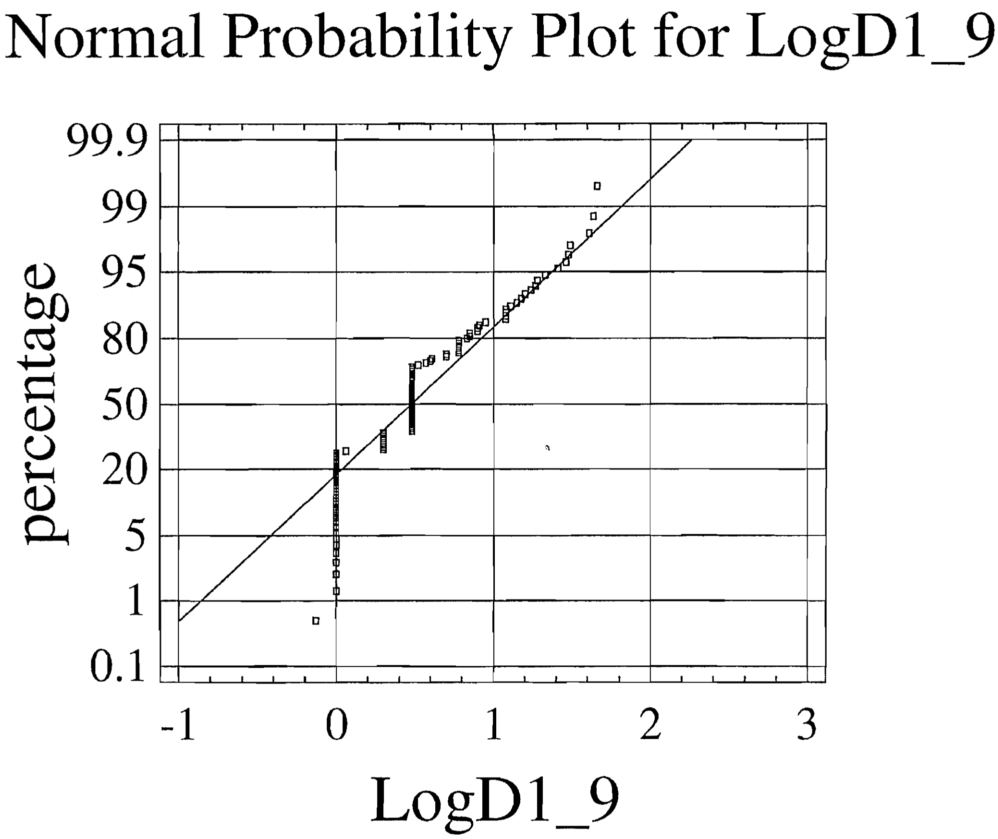


Figure 6-14 Log normal probability plot for distances between features with a transmissivity greater than $1 \cdot 10^{-9}$ m^2/s for data set 1.

As can be noted in *Tables 6-3 to 6-5* the difference between the data sets 1 - 5 are generally very small and the average values presented in *Table 6-2* should be representative for the rock volume around the prototype repository. Possibly a somewhat larger standard deviation (S(Log10 D)) could be used for features with a low transmissivity considering that all directions are censored for distances shorter than 1 m, see *Figure 6-14*, and Appendix 5. Possibly (S(Log10 D)) should not be less than around 0.4 - 0.5 for transmissivity < 10^{-8} m^2/s. In *Figures 6-15 to 6-17* the results are illustrated.

Table 6-2 Distance between hydraulic features with $T > 10^{-6}$, $T > 10^{-7}$, $T > 10^{-8}$, $T > 10^{-9}$, $T > 10^{-10}$ and $T > 10^{-11}$ m^2/s respectively. Summary of data set 1 - 5. (n = sample size, D_a = arithmetic mean, D_{median}= median, D_g = geometric mean, S(Log10 D) = standard deviation.

SUMMARY DATASET 1 - 5						
	LogT>-6	LogT>-7	LogT>-8	LogT>-9	LogT>-10	LogT>-11
SUBCLASS 1						
n	11	40	80	117	175	377
Da	63.73	17.02	8.63	5.99	4.00	1.89
Dmedian	10.23	3.02	3.02	3.02	3.02	1.00
Dg	14.08	5.93	3.24	3.11	2.43	1.42
S(Log10 D)	0.90	0.61	0.53	0.45	0.39	0.26
SUBCLASS 2						
n	2	2	10	23	52	172
Da	163.79	134.03	27.81	12.59	5.84	1.93
Dmedian	56.89	56.89	3.51	3.85	2.00	1.00
Dg	56.89	56.89	8.20	5.67	2.93	1.28
S(Log10 D)	1.05	1.05	0.74	0.61	0.51	0.27
SUBCLASS 3						
n	7	25	43	50	56	78
Da	19.07	7.27	4.08	3.34	2.71	1.78
Dmedian	3.98	3.02	1.00	1.00	1.00	1.00
Dg	6.89	3.41	2.02	1.90	1.74	1.43
S(Log10 D)	0.74	0.42	0.37	0.34	0.32	0.24
SUBCLASS 4						
n	2	8	15	20	30	59
Da	60.00	15.00	8.00	6.00	4.00	2.03
Dmedian	18.84	3.72	3.02	3.02	3.02	1.00
Dg	18.84	6.83	4.54	4.26	2.94	1.70
S(Log10 D)	1.12	0.52	0.45	0.36	0.34	0.26
SUBCLASS 5						
n	0	5	12	25	37	64
Da	-	22.24	9.60	5.04	3.39	1.88
Dmedian	-	19.32	3.02	3.02	3.02	1.00
Dg	-	13.37	4.18	3.67	2.59	1.55
S(Log10 D)	-	0.60	0.57	0.33	0.29	0.23

As mentioned above hydraulic feature in the calculations is per measurement section (1 or 3 m sections). One or more conductive fractures may of course intersect a test section. This means that the conductive fracture frequency should be somewhat higher, at least for low conductive fractures, but also that the transmissivity for individual fractures will be lower as the measured transmissivity in some cases should be divided on a number of fractures. When numerical models are tested one should preferable use 1 m (and 3 m) sections to sample transmissivity - distance distributions that are to be compared with the data presented here.

In a few cases, in nearby sections which all have a high transmissivity, it is possible that the evaluated transmissivity of these sections represent only a single major fracture.

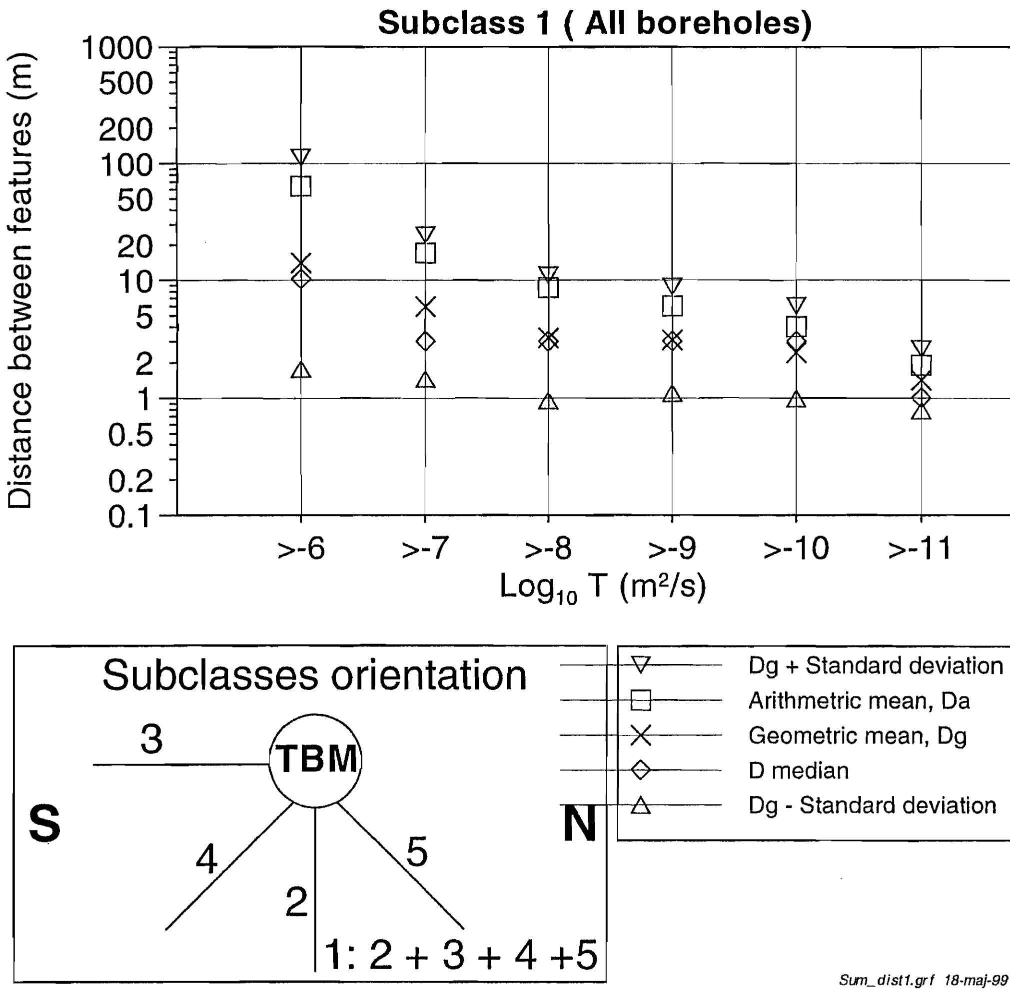


Figure 6-15 Distances between features. Summary of data set 1- 5 for subclass 1 (all boreholes)

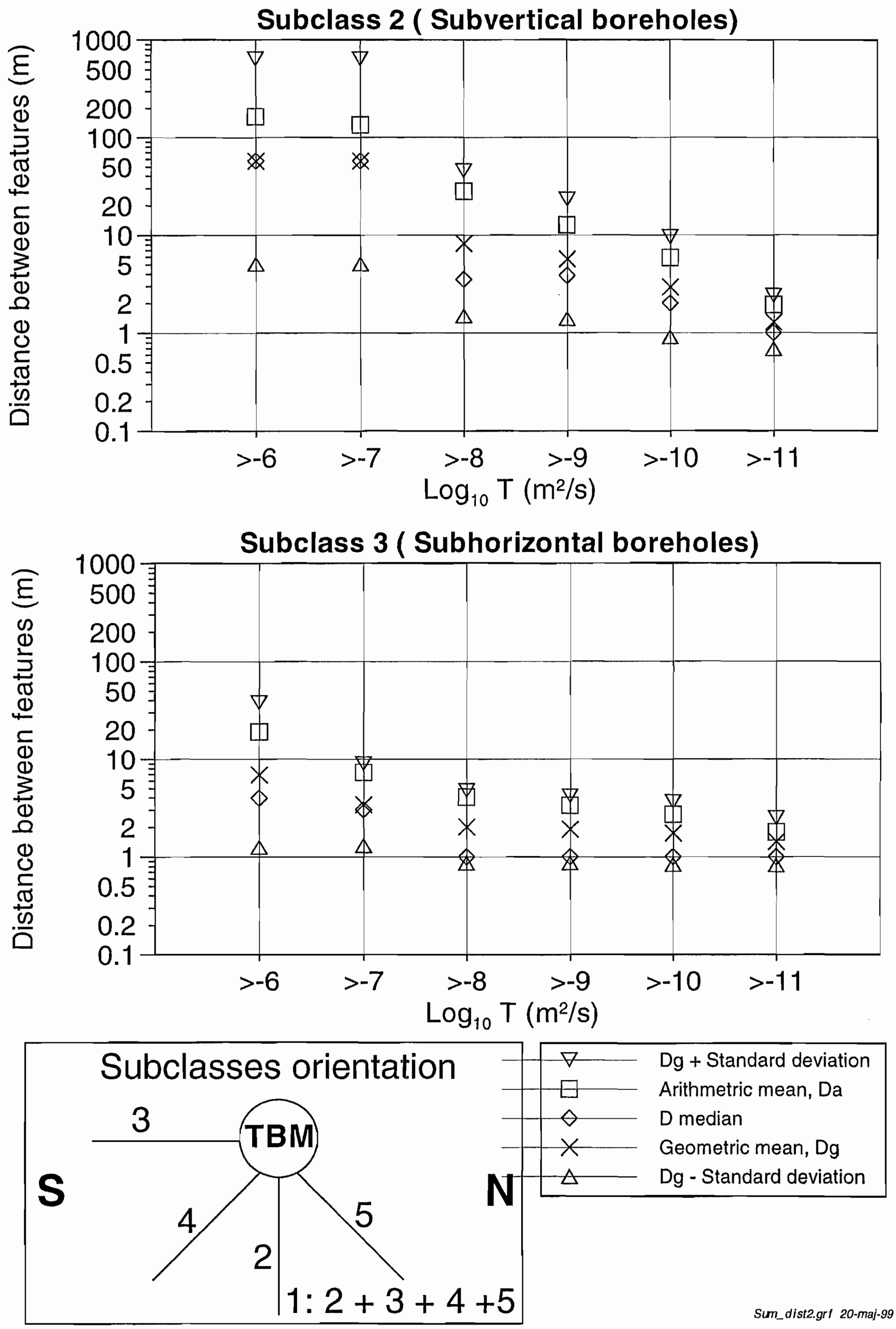


Figure 6-16 Distances between features. Summary of data set 1- 5 for subclass 2 and 3 (vertical and horizontal boreholes)

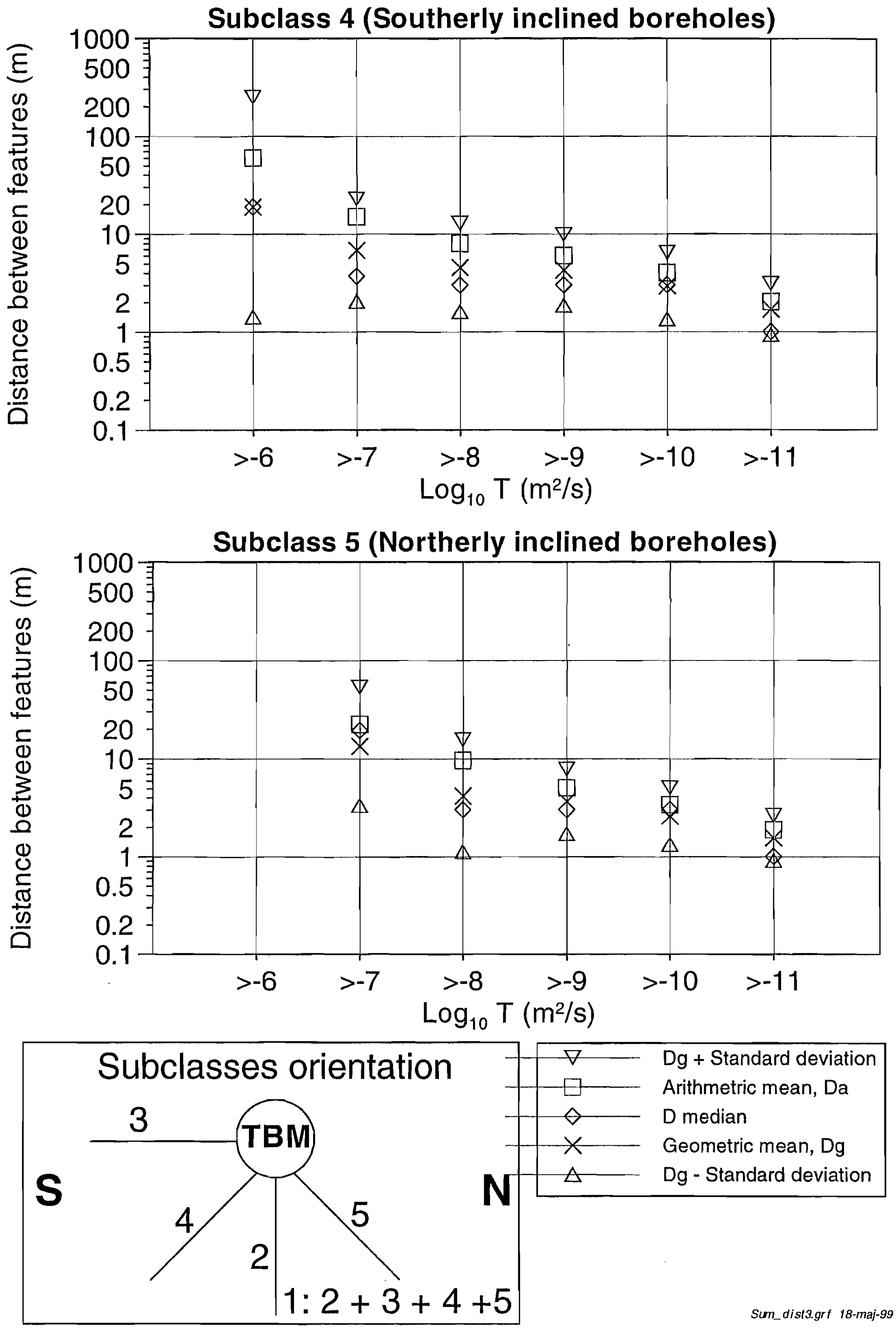


Figure 6-17 Distances between features. Summary of data set 1- 5 for subclass 2 and 3 (southerly and northerly inclined boreholes)

Table 6-3 Distance between hydraulic features with $T > 10^{-6}$, $T > 10^{-7}$, $T > 10^{-8}$, $T > 10^{-9}$, $T > 10^{-10}$ and $T > 10^{-11}$ m^2/s respectively. Maximum and minimum values from data sets 1 - 5 of Dmedian.

Min and max values of Dmedian for datasets 1 - 5						
	LogT>-6	LogT>-7	LogT>-8	LogT>-9	LogT>-10	LogT>-11
SUBCLASS 1						
Max	10.23	3.02	3.02	3.02	3.02	1.00
Min	10.23	3.02	3.02	3.02	3.02	1.00
SUBCLASS 2						
Max	56.89	56.89	3.51	4.07	2.00	1.00
Min	56.89	56.89	3.51	3.72	2.00	1.00
SUBCLASS 3						
Max	3.98	3.02	1.00	1.00	1.00	1.00
Min	3.98	3.02	1.00	1.00	1.00	1.00
SUBCLASS 4						
Max	18.84	4.27	3.02	3.02	3.02	1.00
Min	18.84	3.02	3.02	3.02	3.02	1.00
SUBCLASS 5						
Max		30.90	3.02	3.02	3.02	1.00
Min		7.08	3.02	3.02	3.02	1.00

Table 6-4 Distance between hydraulic features with $T > 10^{-6}$, $T > 10^{-7}$, $T > 10^{-8}$, $T > 10^{-9}$, $T > 10^{-10}$ and $T > 10^{-11}$ m^2/s respectively. Maximum and minimum values from data sets 1 - 5 of D.

Min and max values of Dg for datasets 1 - 5						
	LogT>-6	LogT>-7	LogT>-8	LogT>-9	LogT>-10	LogT>-11
SUBCLASS 1						
Max	14.88	6.09	3.26	3.21	2.44	1.42
Min	13.24	5.78	3.21	3.04	2.41	1.42
SUBCLASS 2						
Max	56.89	56.89	9.40	5.94	3.01	1.29
Min	56.89	56.89	7.38	5.35	2.83	1.27
SUBCLASS 3						
Max	7.01	3.42	2.03	1.90	1.75	1.43
Min	6.81	3.41	2.02	1.89	1.74	1.43
SUBCLASS 4						
Max	18.84	8.01	4.71	4.36	2.98	1.70
Min	18.84	6.29	4.41	4.21	2.91	1.70
SUBCLASS 5						
Max		14.39	4.31	3.68	2.60	1.55
Min		11.80	3.94	3.64	2.57	1.55

Table 6-5 Distance between hydraulic features with $T > 10^{-6}$, $T > 10^{-7}$, $T > 10^{-8}$, $T > 10^{-9}$, $T > 10^{-10}$ and $T > 10^{-11}$ m^2/s respectively. Maximum and minimum values from data sets 1 - 5 of S(Log10 D).

Min and max values of S(Log10 D) for datasets 1 - 5						
	LogT>-6	LogT>-7	LogT>-8	LogT>-9	LogT>-10	LogT>-11
SUBCLASS 1						
Max	0.91	0.62	0.54	0.45	0.39	0.26
Min	0.88	0.61	0.53	0.45	0.39	0.26
SUBCLASS 2						
Max	1.05	1.05	0.77	0.62	0.51	0.28
Min	1.05	1.05	0.70	0.60	0.50	0.26
SUBCLASS 3						
Max	0.75	0.42	0.37	0.34	0.32	0.24
Min	0.74	0.42	0.37	0.34	0.32	0.24
SUBCLASS 4						
Max	1.12	0.53	0.46	0.36	0.34	0.26
Min	1.12	0.51	0.45	0.35	0.33	0.26
SUBCLASS 5						
Max		0.63	0.57	0.33	0.29	0.23
Min		0.59	0.55	0.33	0.29	0.23

6.5 Measurement limit of transmissivity

The statistics for the measurement limit of the transmissivity shown in *Tables 5-8 to 5-15* is shown in *Figure 6-18.*

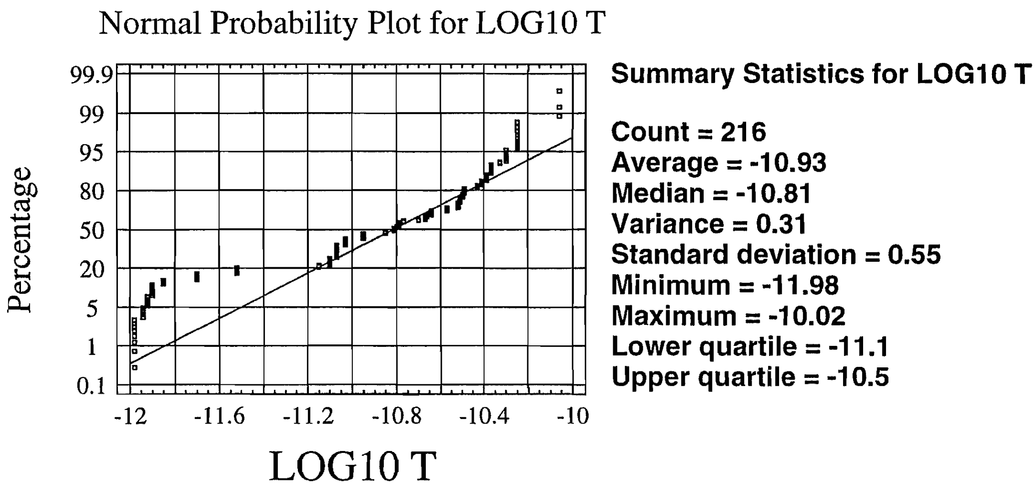


Figure 6-18 Probability distribution of Log10 T.

7 PREDICTION OF INFLOW TO DEPOSITION BOREHOLES

In order to estimate the inflow to the deposition bore hole two alternate equations have been used. They both assume radial flow, which should be applicable in this situation for an approximate calculation of the inflow.

$$Q_{d1} = Q_{TOT} \cdot [P_d \cdot \ln (R_0 / r_w) / (P_0 \cdot \ln (R_0 / r_d))] \qquad (7\text{-}1)$$

$$Q_{d2} = [P_d \cdot 2 \cdot \Pi \cdot T_{TOT} / \ln (R_0 / r_d)] \qquad (7\text{-}2)$$

where

Q_{TOT} = measured inflow to exploratory bore hole out from the top of the packer installation

P_0 = undisturbed pressure measured at the top of the packer installation

P_d = Undisturbed pressure in rock volume intended for the deposition bore hole

R_0 = distance from bore hole centre where undisturbed pressure conditions are assumed

to prevail

r_w = radius of pilot bore hole

r_d = radius of deposition bore hole

T_{TOT} = evaluated transmissivity of bore holes according to *Tables 7-1 to 7-6*

In *Figure 7-1* the schematic layout of the estimation of the inflow to the deposition bore hole is shown.

P_0 was selected from the 8 meters pressure build-up test or from the maximum pressure measured during a feature test or from the regression diagram (at Dt = 10.5 m), *see Figure 6-2,* in that order. T_{TOT} was selected from an 8 meter pressure build-up test if available or a summation of T, *see Tables 5-8 to 5-15,* for the section 0 - 8 m of each bore hole.

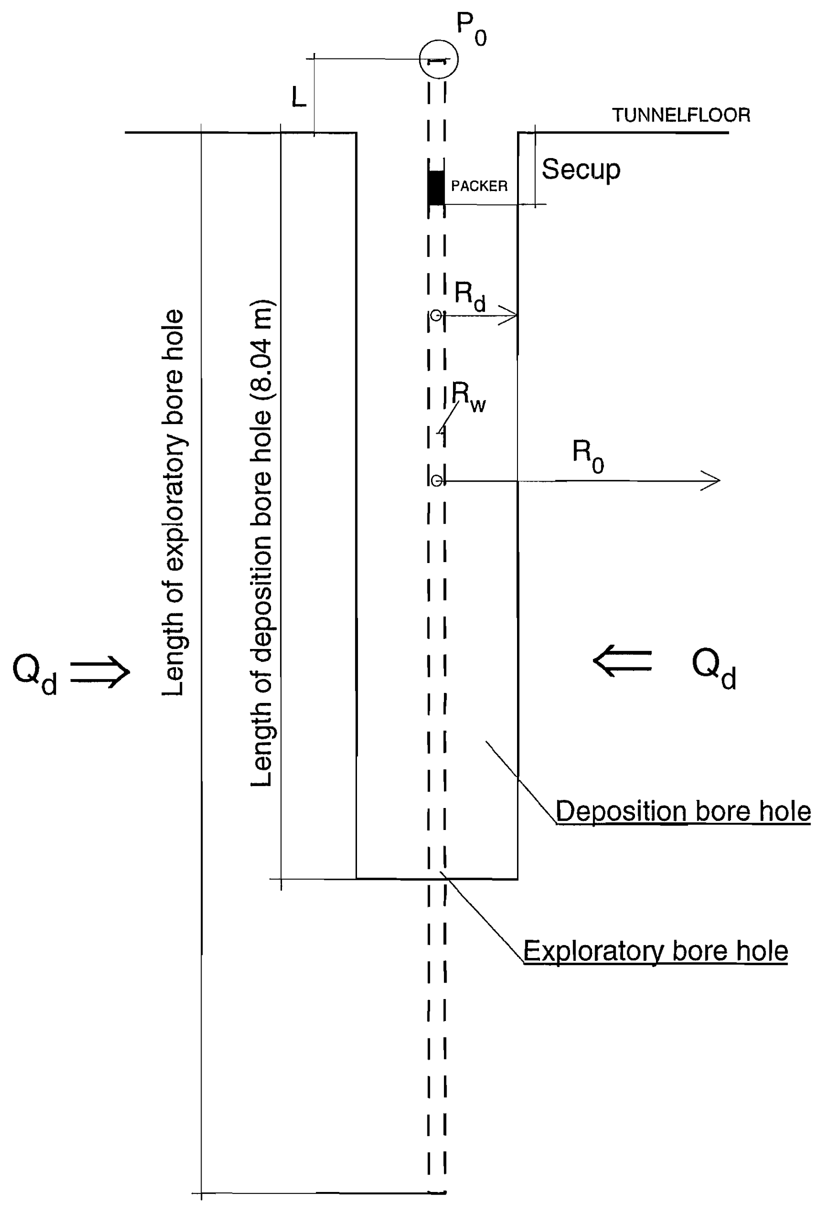


Figure 7-1 Schematic layout of deposition bore hole and exploratory bore hole

Undisturbed maximum pressure in rock volume intended for the deposition bore hole will accordingly be

$P_d = P_0 + L + 8.04$ m where

L = distance of pressure transducer above the tunnel floor, see *Table 4-1.*

The pressure difference causing the flow out from the exploratory hole is P_0 and the pressure difference causing the flow into the deposition hole is P_d, as there is atmospheric pressure in the deposition holes after drilling. In *Tables 7-1 to 7-6* the result of this analysis is presented.

In *Tables 7-1 to 7-6* and in *Figures 7-2 to 7-7* each bore hole is marked with drill batch 1, 2 or 3 in order to indicate the stepwise increased information about the properties around the deposition boreholes. Boreholes from drill batch 1 are drilled slightly inclined toward the south-west and within the planned deposition boreholes. A borehole in drill batch 2 is sub-vertical and generally very close to the deposition holes (a few decimetres outside or inside to a few meters outside the planned deposition boreholes. Boreholes in drill batch 3 are sub-vertical and inclined near deposition boreholes1, 4, 5 and 6. There are 3 sub-vertical boreholes very close or inside 4 of the deposition holes (1, 3, 5 and 6), see *Figure 4-2*.

As can be noticed in *Table 7-1 to 7-7* the predicted mean inflow show major increases rather much from drill batch 1 to 2 and a slight increase from drill batch 2 to 3, except for deposition holes 4 and 6 which are almost constant. For deposition boreholes 1 and 6, the inclined boreholes from drill batch 3 give the extreme values, see *Figures 7-2 and 7-7*. As the exploratory bore hole radius is very small compared with the radius of the deposition boreholes it is likely that the deposition holes will intersect one or several features with as high transmissivity as the highest found in the exploratory boreholes.

It is therefor considered that the maximum calculated flow from a single observation hole may be the most relevant prediction for the inflow to the deposition holes. Two-phase flow effects and other EDZ (Excavation Distracted Zone) effects may however limit the flow rates into the deposition boreholes. In *Table 7-8* the maximum calculated flow rates (Q_{d1} and Q_{d2}) for each deposition hole is summarised. The maximum predicted inflow based on the sub-vertical boreholes is about 0.1 - 0.3 l/min. The highest predicted inflows, which are about 1 - 30 l/min are for deposition holes 1 and 6 and are based on two of the inclined boreholes.

The prediction of the inflow based on the evaluated transmissivity gives higher inflow rates compared to the prediction based on the measured flow rate and pressure in the boreholes. The predictions based on the transmissivity gives on average 3 - 4 times higher flow rates, see *Table 7-7*. In single cases 2 - 7 times higher flow rates and in two cases 20 and 50 times higher flow rates and in one case 5 times lower flow rates, see *Tables 7-1 to 7-6*. The first set of statistical parameters is for estimated inleakage rates for boreholes drilled during drilling campaign 1 and 2, while the second set of statistical parameters is for boreholes drilled during drilling campaign 1, 2 and 3.

In *Figures 7-2 to 7-7* the values of the second set are indicated with dotted lines. A statistical analysis with all boreholes in *Tables 7-1 to 7-6* is presented in *Table 7-7*.

Table 7-1 Estimation of inleakage to deposition bore hole 1. R_0 = 10 m, r_d = 0.875 m, r_w = 0.038 m, $P_d = P_0 + L + 8.04$ m. X_m = mean at Log_{10} (X), S = standard deviation of Log_{10} (X)

Bore hole	Drilling campaign	Q_{TOT} (l/min)	T_{TOT} (m²/s)	P_d (m)	P_d / P_0	Q_{d1} (l/min)	Q_{d2} (l/min)
KA3584G01	2	0.00017	$6.8 \cdot 10^{-11}$	179.04	1.05	0.00041	0.00188
KA3586G01	2	0.00001	$1.3 \cdot 10^{-11}$	34.98	1.37	0.000031	0.000070
KA3587G	1	0.0001	$2.1 \cdot 10^{-11}$	142.83	1.07	0.000194	0.000458
KA3588G01	2	0.0230	$8.4 \cdot 10^{-9}$	216.62	1.05	0.0550	0.2820
KA3590G01	3	0.43087	$4.2 \cdot 10^{-7}$	313.21	1.03	1.01	20.4
KA3590G02	3	0.00055	$2.5 \cdot 10^{-10}$	179.04	1.05	0.00133	0.00693
X_m + S	1+2					0.015	0.071
X_m	1+2					$6.09 \cdot 10^{-4}$	$2.03 \cdot 10^{-3}$
X_m - S	1+2					$2.51 \cdot 10^{-5}$	$5.83 \cdot 10^{-5}$
X_m + S	1+2+3					0.114	1.160
X_m	1+2+3					$2.39 \cdot 10^{-3}$	$1.16 \cdot 10^{-2}$
X_m - S	1+2+3					$4.97 \cdot 10^{-5}$	$1.16 \cdot 10^{-4}$

The first set of statistical parameters is for estimated inleakage rates for boreholes drilled during drilling campaign 1 and 2, while the second set of statistical parameters is for boreholes drilled during drilling campaign 1, 2 and 3. In *Figure 7-2* the values of the second set are indicated with dotted lines.

Table 7-2 Estimation of inleakage to deposition bore hole 2. R_0 = 10 m, r_d = 0.875 m, r_w = 0.038 m, $P_d = P_0 + L + 8.04$ m. X_m = mean at Log_{10} (X), S = standard deviation of Log_{10} (X)

Bore hole	Drilling campaign	Q_{TOT} (l/min)	T_{TOT} (m^2/s)	P_d (m)	P_d / P_0	Q_{d1} (l/min)	Q_{d2} (l/min)
KA3578G01	2	0.00186	$4.3 \cdot 10^{-10}$	179.04	1.05	0.00448	0.0119
KA3579G	3	0.00050	$7.5 \cdot 10^{-12}$	179.04	1.05	0.00120	0.000208
KA3581G	1	$1.3 \cdot 10^{-6}$	$8.7 \cdot 10^{-12}$	14.68	2.97	$8.84 \cdot 10^{-6}$	$2.0 \cdot 10^{-5}$
KA3584G01	2	0.00017	$6.8 \cdot 10^{-11}$	179.04	1.05	0.00041	0.00188
X_m + S	1+2					0.00586	0.0205
X_m	1+2					$2.53 \cdot 10^{-4}$	$7.62 \cdot 10^{-4}$
X_m - S	1+2					$1.09 \cdot 10^{-5}$	$2.83 \cdot 10^{-5}$
X_m + S	1+2+3					0.00545	0.00876
X_m	1+2+3					$3.74 \cdot 10^{-4}$	$5.51 \cdot 10^{-4}$
X_m - S	1+2+3					$2.56 \cdot 10^{-5}$	$3.47 \cdot 10^{-5}$

The first set of statistical parameters is for estimated inleakage rates for boreholes drilled during drilling campaign 1 and 2, while the second set of statistical parameters is for boreholes drilled during drilling campaign 1, 2 and 3. In *Figure 7-3* the values of the second set are indicated with dotted lines.

Table 7-3 Estimation of inleakage to deposition bore hole 3. R_0 = 10 m, r_d = 0.875 m, r_w = 0.038 m, $P_d = P_0 + L + 8.04$ m. X_m = mean at Log_{10} (X), S = standard deviation of Log_{10} (X)

Bore hole	Drilling campaign	Q_{TOT} (l/min)	T_{TOT} (m^2/s)	P_d (m)	P_d / P_0	Q_{d1} (l/min)	Q_{d2} (l/min)
KA3572G01	2	0.00176	$1.1 \cdot 10^{-9}$	179.04	1.05	0.00424	0.03050
KA3574G01	3	0.00077	$4.3 \cdot 10^{-10}$	179.04	1.05	0.00186	0.0119
KA3575G	1	$8.4 \cdot 10^{-6}$	$1.9 \cdot 10^{-10}$	11.92	5.47	0.000105	0.000344
KA3576G01	3	0.00040	$1.8 \cdot 10^{-9}$	179.04	1.05	0.000964	0.0499
KA3578G01	2	0.00186	$4.3 \cdot 10^{-10}$	179.04	1.05	0.00448	0.0119
X_m + S	1+2					0.0108	0.0532
X_m	1+2					$1.26 \cdot 10^{-3}$	$5.00 \cdot 10^{-3}$
X_m - S	1+2					$1.46 \cdot 10^{-4}$	$4.70 \cdot 10^{-4}$
X_m + S	1+2+3					0.00601	0.06626
X_m	1+2+3					$1.29 \cdot 10^{-3}$	$9.42 \cdot 10^{-3}$
X_m - S	1+2+3					$2.77 \cdot 10^{-4}$	$1.34 \cdot 10^{-3}$

The first set of statistical parameters is for estimated inleakage rates for boreholes drilled during drilling campaign 1 and 2, while the second set of statistical parameters is for boreholes drilled during drilling campaign 1, 2 and 3. In *Figure 7-4* the values of the second set are indicated with dotted lines.

Table 7-4 Estimation of inleakage to deposition bore hole 4. R_0 = 10 m, r_d = 0.875 m, r_w = 0.038 m, $P_d = P_0 + L + 8.04$ m. X_m = mean at Log_{10} (X), S = standard deviation of Log_{10} (X)

Bore hole	Drilling campaign	Q_{TOT} (l/min)	T_{TOT} (m^2/s)	P_d (m)	P_d / P_0	Q_{d1} (l/min)	Q_{d2} (l/min)
KA3566G01	3	0.00211	$7.5 \cdot 10^{-10}$	179.04	1.05	0.00508	0.0208
KA3566G02	3	0.00167	$5.3 \cdot 10^{-10}$	179.04	1.05	0.00402	0.0147
KA3569G	1	0.00038	$4.2 \cdot 10^{-10}$	53.97	1.22	0.00106	0.00354
KA3572G01	2	0.00213	$1.1 \cdot 10^{-9}$	179.04	1.05	0.00513	0.0305
X_m + S	1+2					0.00711	0.0476
X_m	1+2					$2.33 \cdot 10^{-3}$	$1.04 \cdot 10^{-2}$
X_m - S	1+2					$7.65 \cdot 10^{-4}$	$2.27 \cdot 10^{-3}$
X_m + S	1+2+3					0.00690	0.03450
X_m	1+2+3					$3.25 \cdot 10^{-3}$	$1.35 \cdot 10^{-2}$
X_m - S	1+2+3					$1.53 \cdot 10^{-3}$	$5.27 \cdot 10^{-3}$

The first set of statistical parameters is for estimated inleakage rates for boreholes drilled during drilling campaign 1 and 2, while the second set of statistical parameters is for boreholes drilled during drilling campaign 1, 2 and 3. In *Figure 7-5* the values of the second set are indicated with dotted lines.

Table 7-5 Estimation of inleakage to deposition bore hole 5. R_0 = 10 m, r_d = 0.875 m, r_w = 0.038 m, $P_d = P_0 + L + 8.04$ m. X_m = mean at Log_{10} (X), S = standard deviation of Log_{10} (X)

Bore hole	Drilling campaign	Q_{TOT} (l/min)	T_{TOT} (m^2/s)	P_d (m)	P_d / P_0	Q_{d1} (l/min)	Q_{d2} (l/min)
KA3548G01	2	0.01154	$3.5 \cdot 10^{-9}$	222.94	1.04	0.0274	0.121
KA3550G01	2	0.01563	$4.6 \cdot 10^{-9}$	233.95	1.04	0.0370	0.167
KA3551G	1	$2.2 \cdot 10^{-5}$	$8.4 \cdot 10^{-12}$	92.17	1.12	$5.63 \cdot 10^{-5}$	$1.20 \cdot 10^{-4}$
KA3552G01	2	0.01057	$6.3 \cdot 10^{-9}$	114.71	1.08	0.0260	0.112
KA3554G01	3	0.00983	$2.7 \cdot 10^{-9}$	179.04	1.05	0.0237	0.0748
KA3554G02	3	0.00158	$4.1 \cdot 10^{-10}$	179.04	1.05	0.00381	0.0114
X_m + S	1+2					0.143	0.758
X_m	1+2					$6.21 \cdot 10^{-3}$	$2.28 \cdot 10^{-2}$
X_m - S	1+2					$2.69 \cdot 10^{-4}$	$6.87 \cdot 10^{-3}$
X_m + S	1+2+3					0.020	0.400
X_m	1+2+3					$7.15 \cdot 10^{-3}$	$2.48 \cdot 10^{-2}$
X_m - S	1+2+3					$2.57 \cdot 10^{-3}$	$1.54 \cdot 10^{-3}$

The first set of statistical parameters is for estimated inleakage rates for boreholes drilled during drilling campaign 1 and 2, while the second set of statistical parameters is for boreholes drilled during drilling campaign 1, 2 and 3. In *Figure 7-6* the values of the second set are indicated with dotted lines.

Table 7-6 Estimation of inleakage to deposition bore hole 6. R_0 = 10 m, r_d = 0.875 m, r_w = 0.038 m, $P_d = P_0 + L + 8.04$ m. X_m = mean at Log_{10} (X), S = standard deviation of Log_{10} (X)

Bore hole	Drilling campaign	Q_{TOT} (l/min)	T_{TOT} (m^2/s)	P_d (m)	P_d / P_0	Q_{d1} (l/min)	Q_{d2} (l/min)
KA3542G01	3	0.00116	$1.5 \cdot 10^{-10}$	179.04	1.05	0.00279	0.00416
KA3542G02	3	2.78241	$6.7 \cdot 10^{-7}$	294.14	1.03	6.55	30.5
KA3544G01	2	0.0047	$1.5 \cdot 10^{-9}$	179.04	1.05	0.0113	0.0416
KA3545G	1	0.0130	$2.1 \cdot 10^{-9}$	242.63	1.04	0.0310	0.0788
KA3546G01	2	0.01059	$2.3 \cdot 10^{-9}$	179.04	1.05	0.0255	0.0637
KA3548G01	2	0.01154	$3.5 \cdot 10^{-9}$	222.94	1.04	0.0274	0.121
X_m + S	1+2					0.0352	0.111
X_m	1+2					$2.22 \cdot 10^{-2}$	$7.09 \cdot 10^{-2}$
X_m - S	1+2					$1.41 \cdot 10^{-2}$	$4.55 \cdot 10^{-2}$
X_m + S	1+2+3					0.574	2.333
X_m	1+2+3					$4.06 \cdot 10^{-2}$	$1.21 \cdot 10^{-1}$
X_m - S	1+2+3					$2.87 \cdot 10^{-3}$	$6.32 \cdot 10^{-3}$

The first set of statistical parameters is for estimated inleakage rates for boreholes drilled during drilling campaign 1 and 2, while the second set of statistical parameters is for boreholes drilled during drilling campaign 1, 2 and 3. In *Figure 7-7* the values of the second set are indicated with dotted lines.

Table 7-7 Statistical analysis of inleakage rates of all boreholes presented in Tables 7-1 to 7-6.

Bore hole	Drilling campaign	Q_{d1} (l/min)	Q_{d2} (l/min)
$X_m + S$	1	0.00438	0.0123
X_m	1	$2.64 \cdot 10^{-4}$	$6.89 \cdot 10^{-4}$
$X_m - S$	1	$1.59 \cdot 10^{-5}$	$3.87 \cdot 10^{-5}$
$X_m + S$	1+2	0.0360	0.146
X_m	1+2	$1.94 \cdot 10^{-3}$	$6.43 \cdot 10^{-3}$
$X_m - S$	1+2	$1.05 \cdot 10^{-4}$	$2.83 \cdot 10^{-4}$
$X_m + S$	1+2+3	0.0741	0.392
X_m	1+2+3	$3.78 \cdot 10^{-3}$	$1.37 \cdot 10^{-2}$
$X_m - S$	1+2+3	$1.93 \cdot 10^{-4}$	$4.80 \cdot 10^{-4}$

Table 7-8 Maximum calculated flow rate for each deposition bore hole

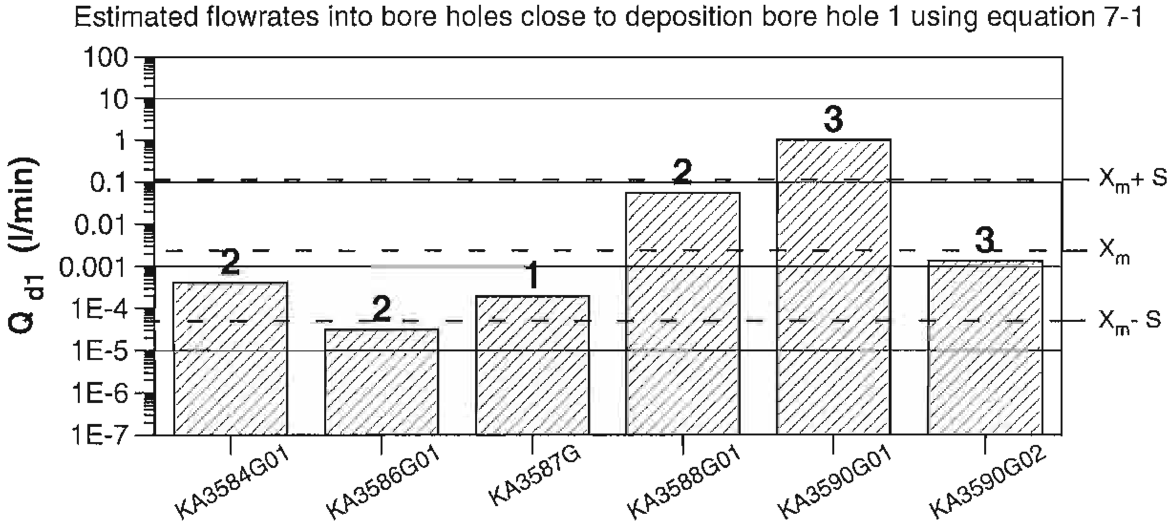
Deposition bore hole	Qd1 (l/min)	Qd2 (l/min)
1=DA3587G01	1.01	20.4
2=DA3581G01	0.00448	0.0119
3=DA3576G01	0.00448	0.0119
4=DA3569G01	0.00513	0.0305
5=DA3551G01	0.0370	0.167
6=DA3545G01	6.55	30.5

For the bore hole dimensions above the different geometrical scaling factors, in the equations 7-1 and 7-2, varies as below in *Table 7-9*. When increasing the radius 10 times the first scaling factor decreases to 70 % , i.e. the inflow rate to the deposition bore hole decreases to 70 % of the value of Q_{d1} reported in *Tables 7-1 to 7-6*. The second scaling factor increases to almost 200 %, i.e. the inflow rate to the deposition bore hole decreases to 50 % of the value of Q_{d2} reported in Table 7-2 to 7-7. As can be seen in *Table 7-9* the choice of influence radius R_0 on Q_d is considerably less than the actual measured values of the other factors in equations 7-1 and 7-2.

The two methods give apparently similar results with only minor differences

Table 7-9 Scaling factors in eq. 7-1 and 7-2.

R_0 (m)	[ln (R_0 / r_w)/ln (R_0 / r_d)]	[ln (R_0 / r_d)]
10	2.288	2.436
30	1.887	3.535
100	1.662	4.739



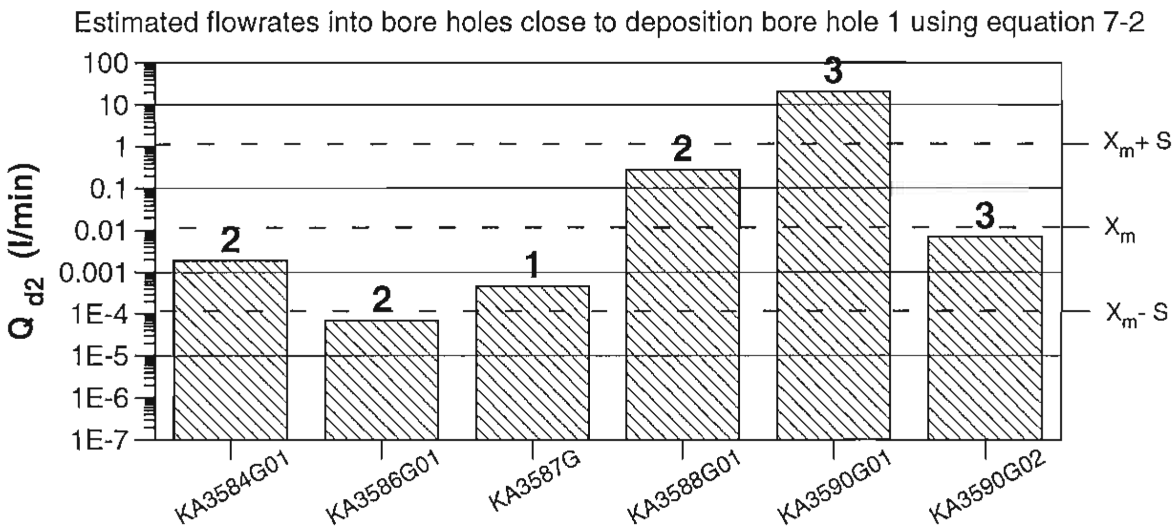
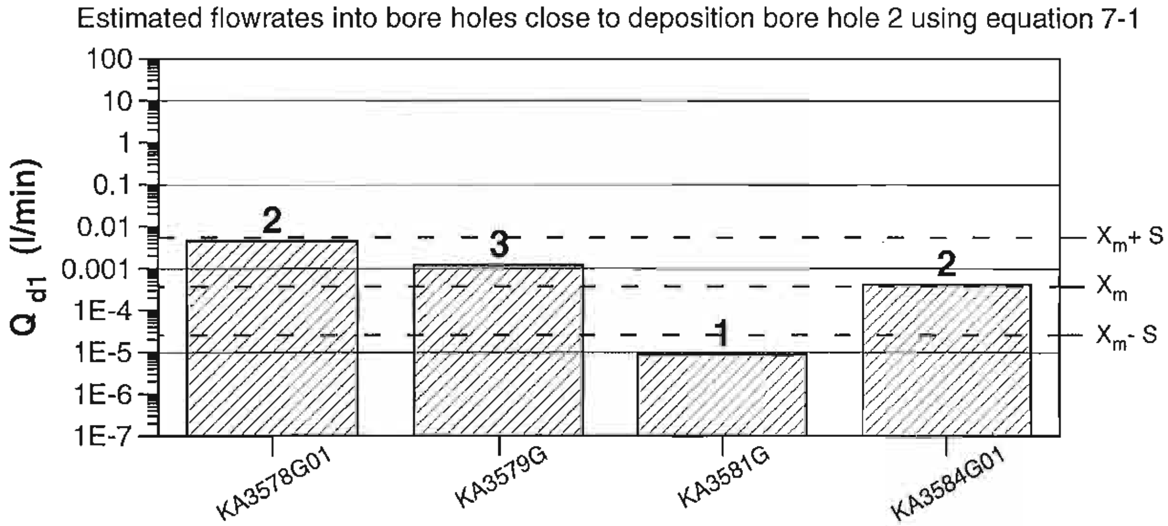


Figure 7-2 Estimated flow rates according to Table 7-1. X_m = mean at Log_{10} (X), S = standard deviation of Log_{10} (X). Drilling campaign number indicated on top of bars.



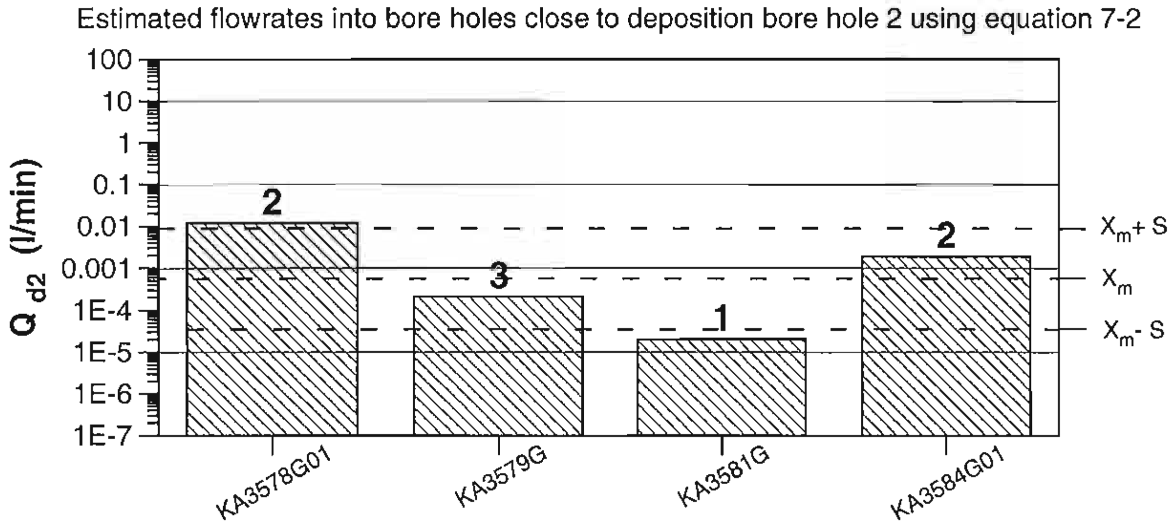
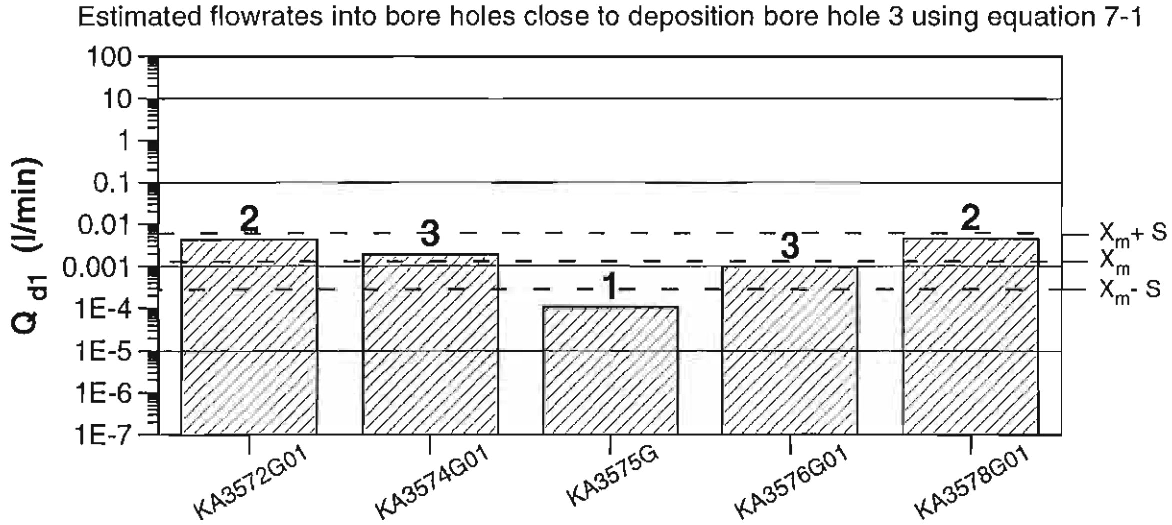


Figure 7-3 Estimated flow rates according to Table 7-2. X_m = mean at Log_{10} (X), S = standard deviation of Log_{10} (X). Drilling campaign number indicated on top of bars.



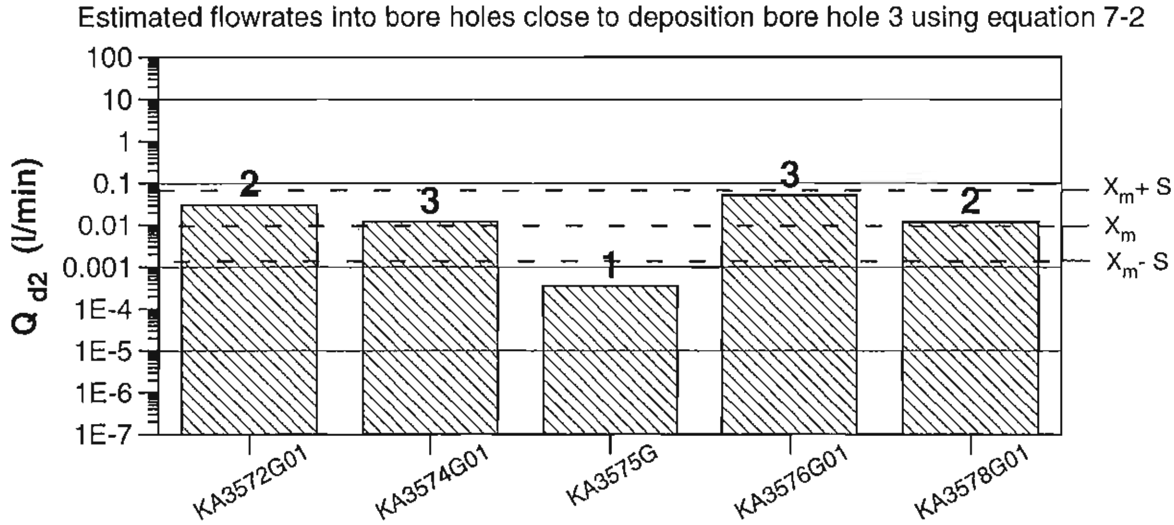
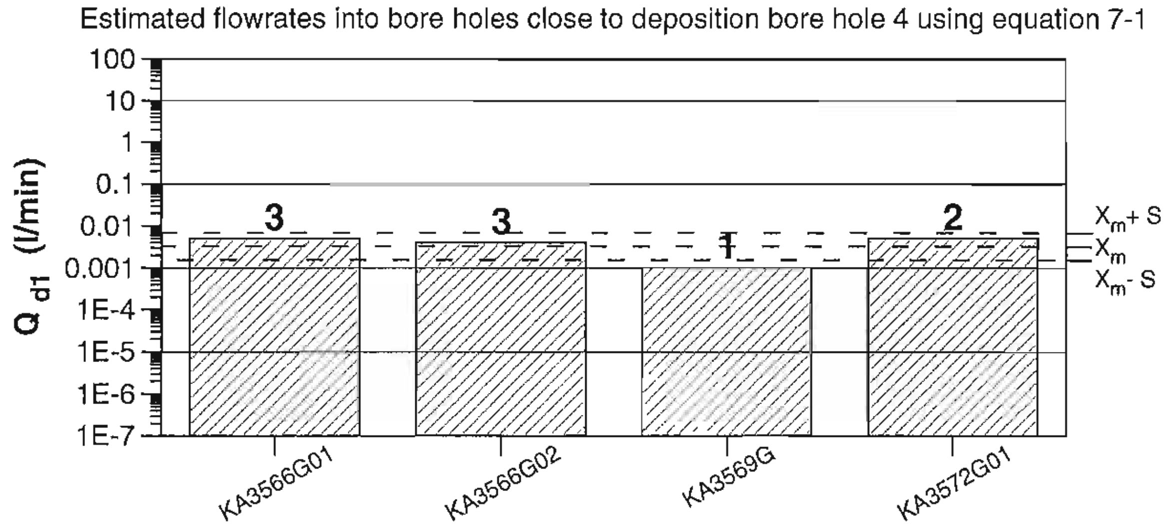


Figure 7-4 Estimated flow rates according to Table 7-3. Xm = mean at Log10 (X), S = standard deviation of Log10 (X). Drilling campaign number indicated on top of bars.



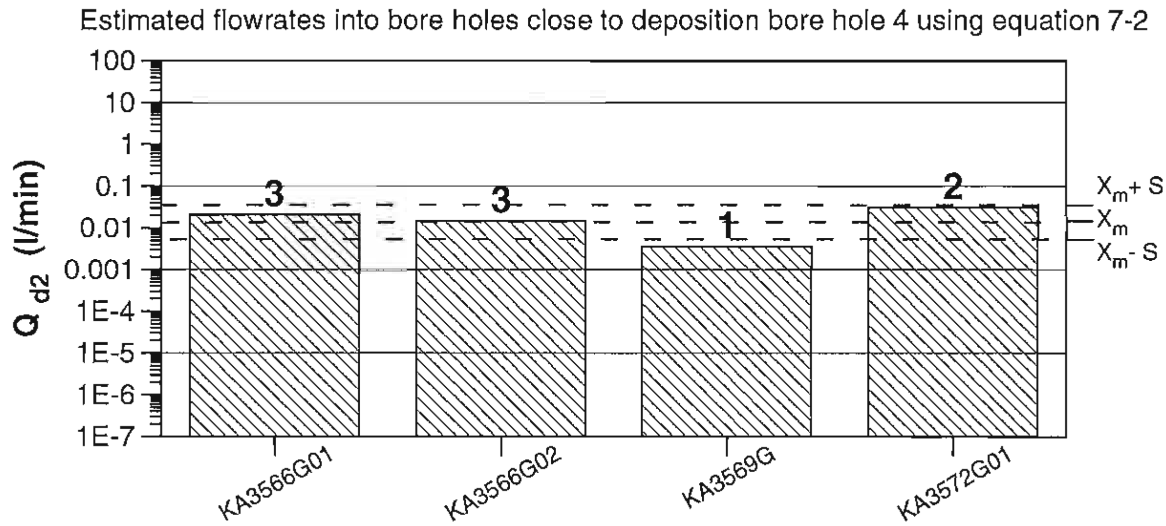
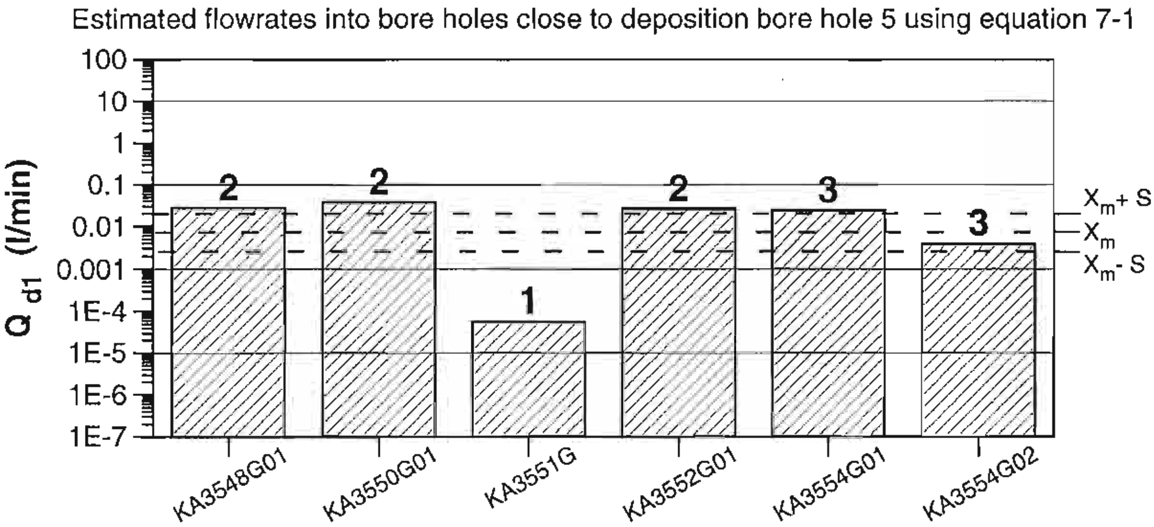


Figure 7-5 Estimated flow rates according to Table 7-4. Xm = mean at Log10 (X), S = standard deviation of Log10 (X). Drilling campaign number indicated on top of bars.



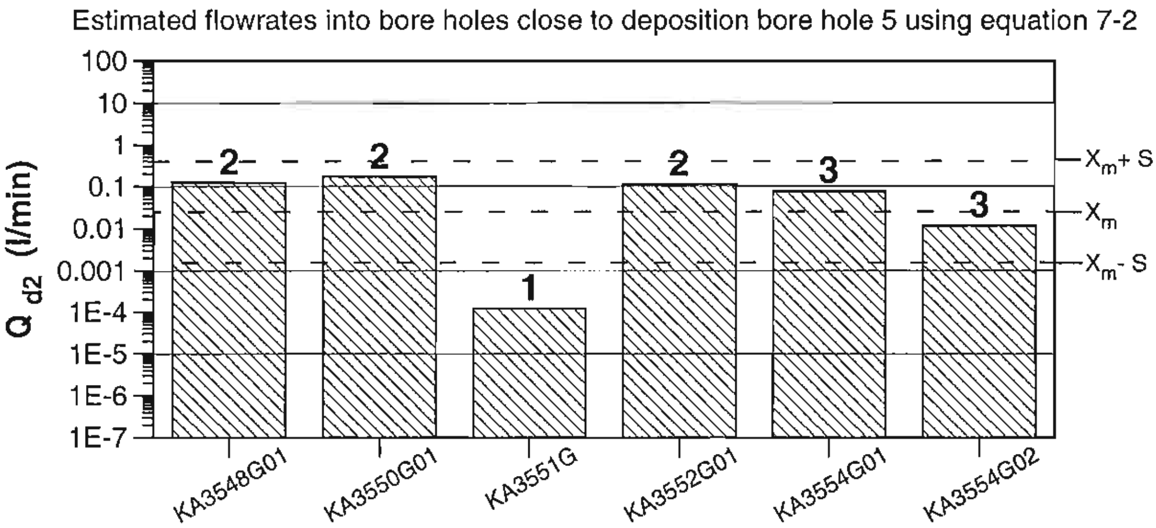


Figure 7-6 Estimated flow rates according to Table 7-5. Xm = mean at Log10 (X), S = standard deviation of Log10 (X). Drilling campaign number indicated on top of bars.

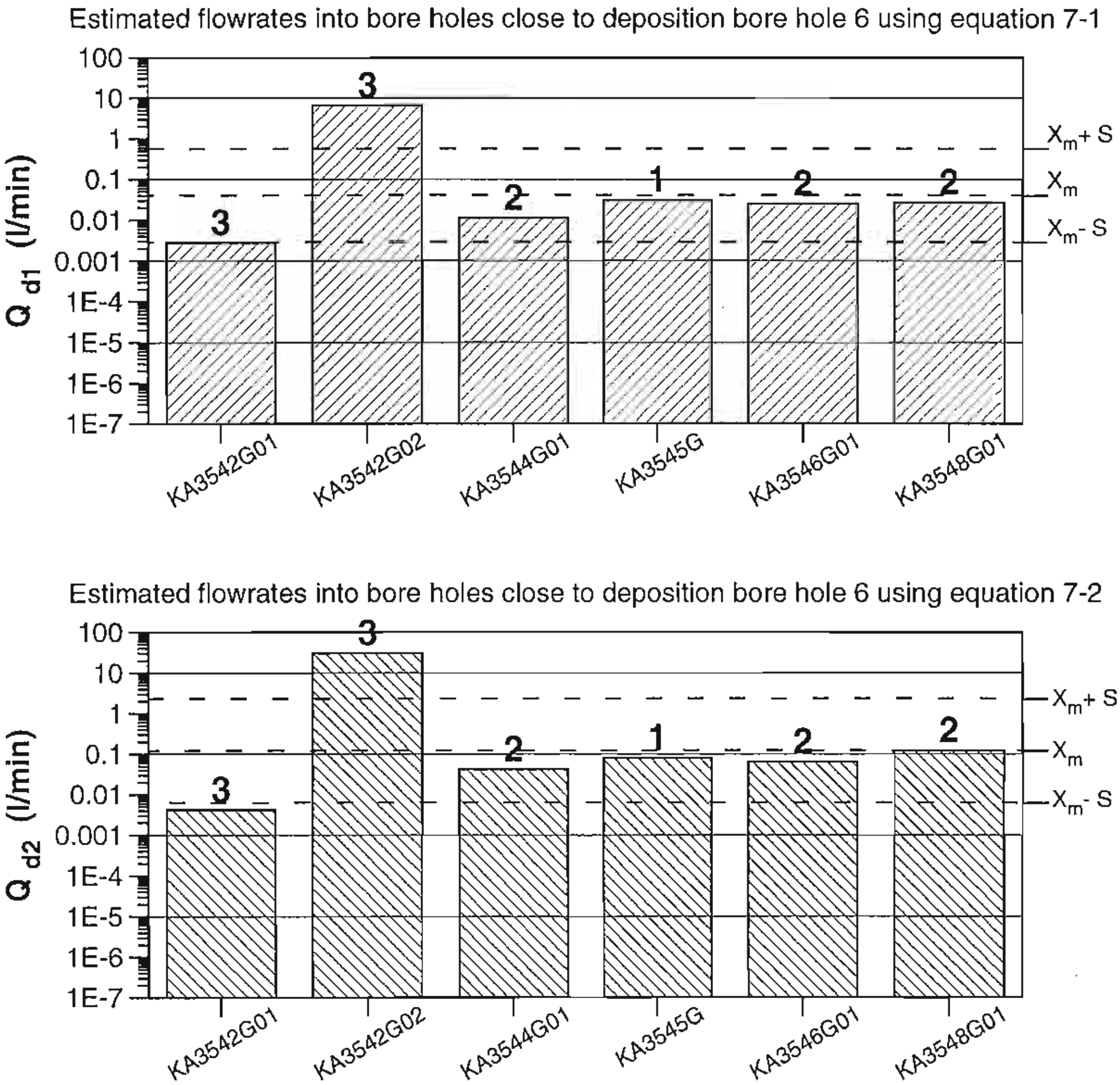


Figure 7-7 Estimated flow rates according to Table 7-6. Xm = mean at Log10 (X), S = standard deviation of Log10 (X). Drilling campaign number indicated on top of bars.

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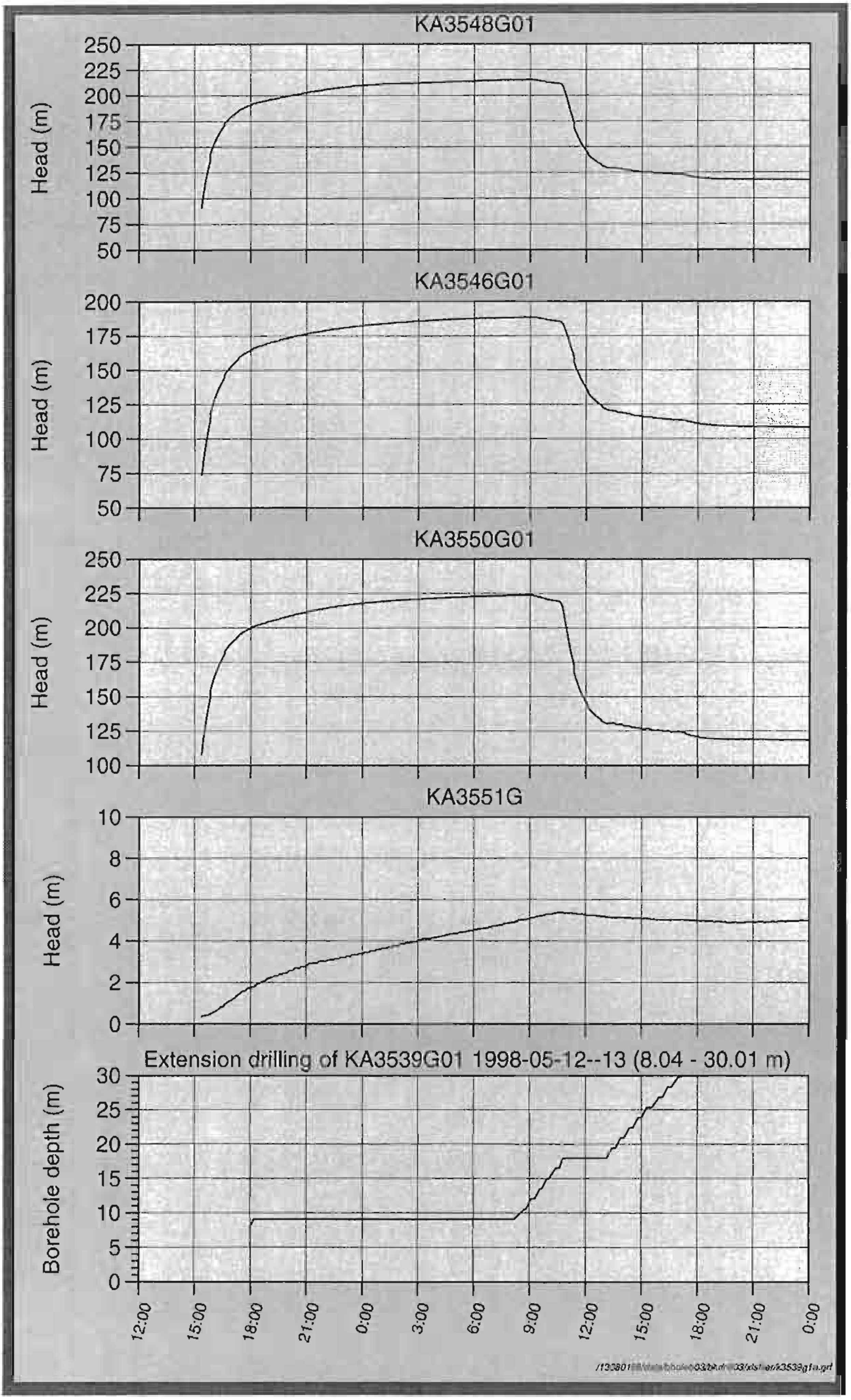
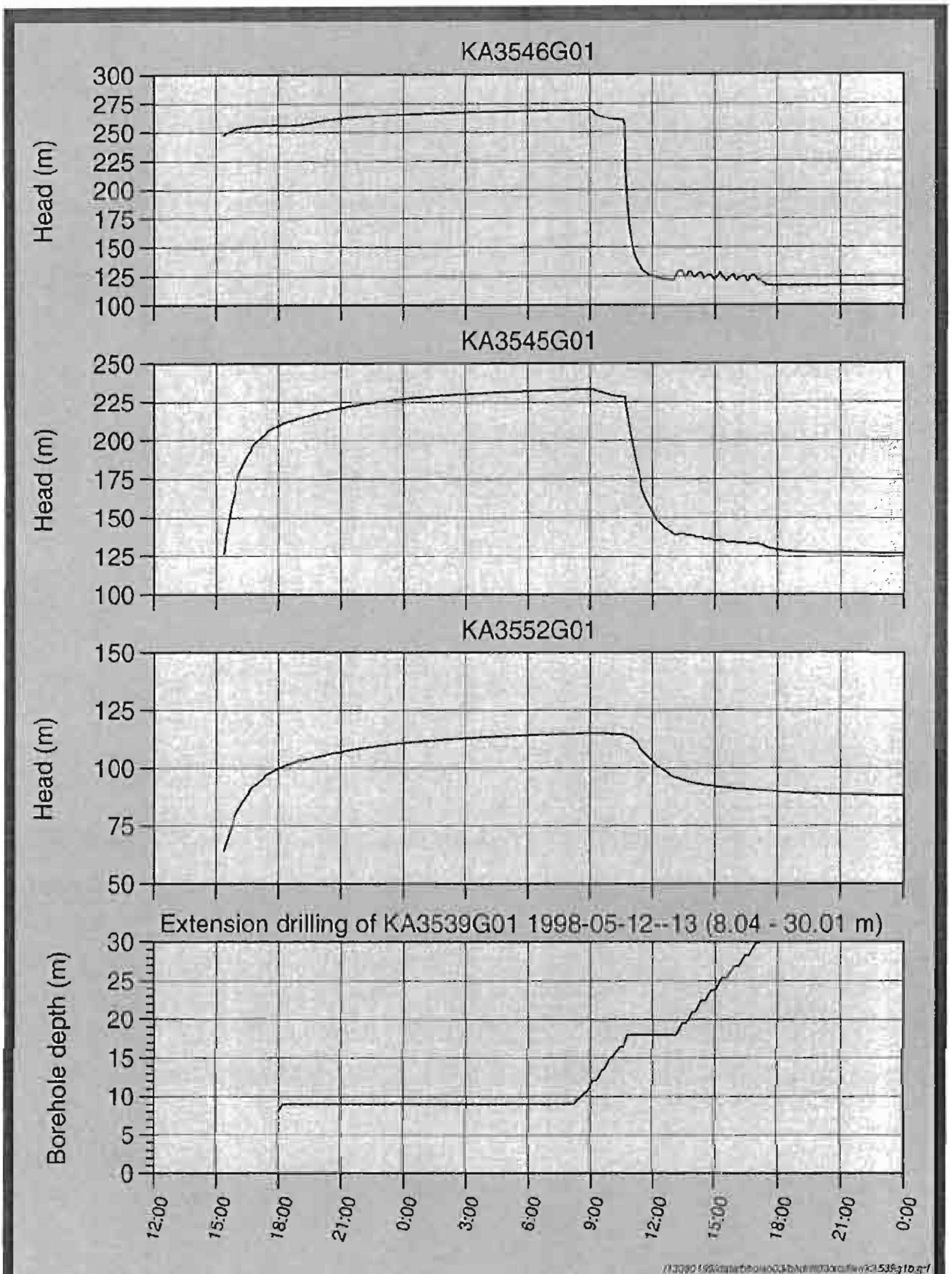
APPENDIX 1

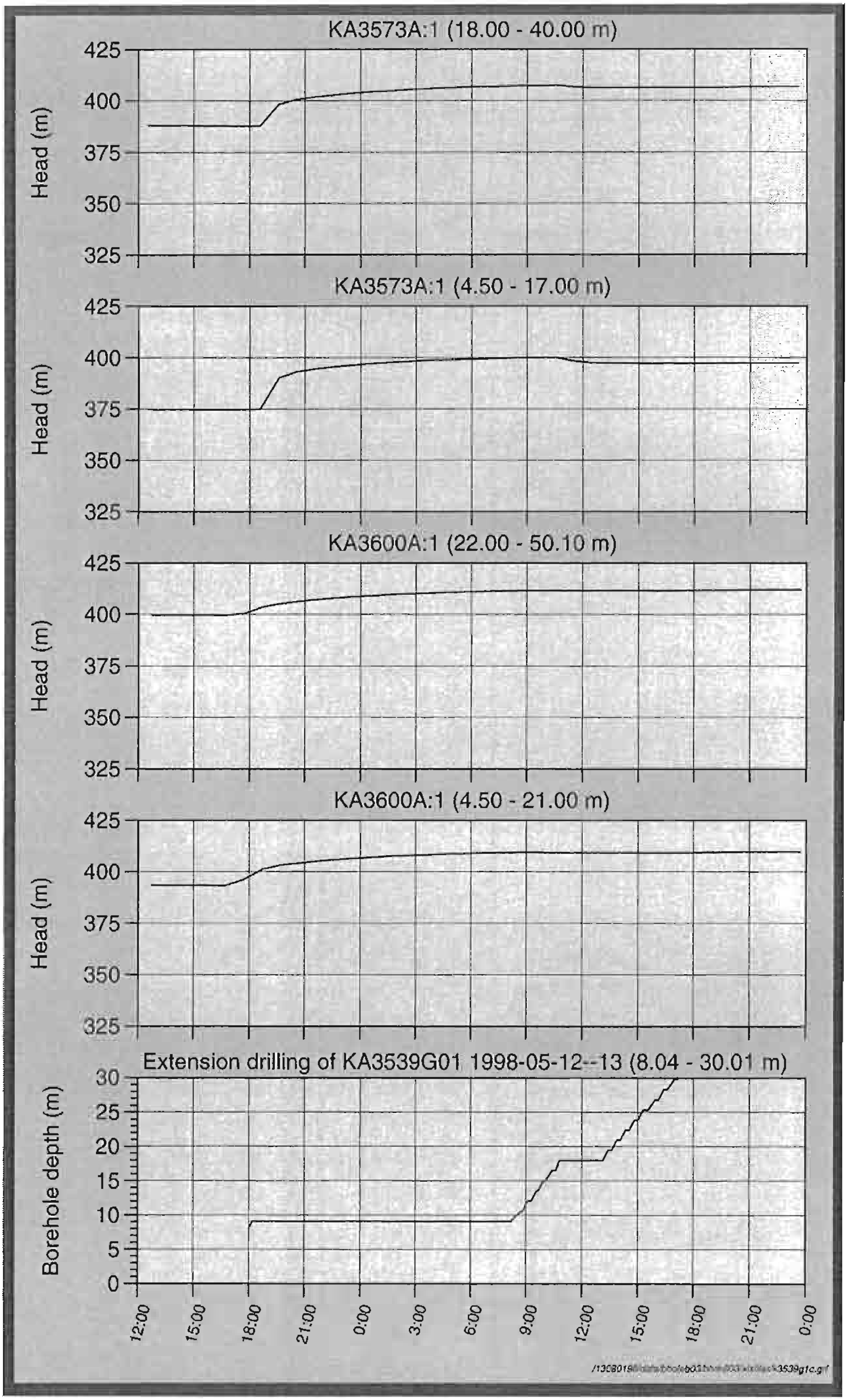
Pressure response during drilling of

- KA3539G, 0.00 - 30.01 m
- KA3542G01, 0.00 - 30.04 m
- KA3542G02, 0.00 - 30.01 m
- KA3548A01, 0.00 - 30.00 m
- KA3554G01, 0.00 - 30.01 m
- KA3554G02, 0.00 - 30.01 m
- KA3557G, 0.00 - 30.04 m
- KA3563G, 0.00 - 30.00 m
- KA3566G01, 0.00 - 30.01 m
- KA3566G02, 0.00 - 30.01 m
- KA3574G01, 0.00 - 12.00 m
- KA3576G01, 0.00 - 12.01 m
- KA3579G01, 0.00 - 22.65 m
- KA3590G01, 0.00 - 30.06 m
- KA3590G02, 0.00 - 30.05 m
- KA3593G01, 0.00 - 30.02 m
- KG0021A01, 0.00 - 48.82 m
- KG0048A01, 0.00 - 54.69 m

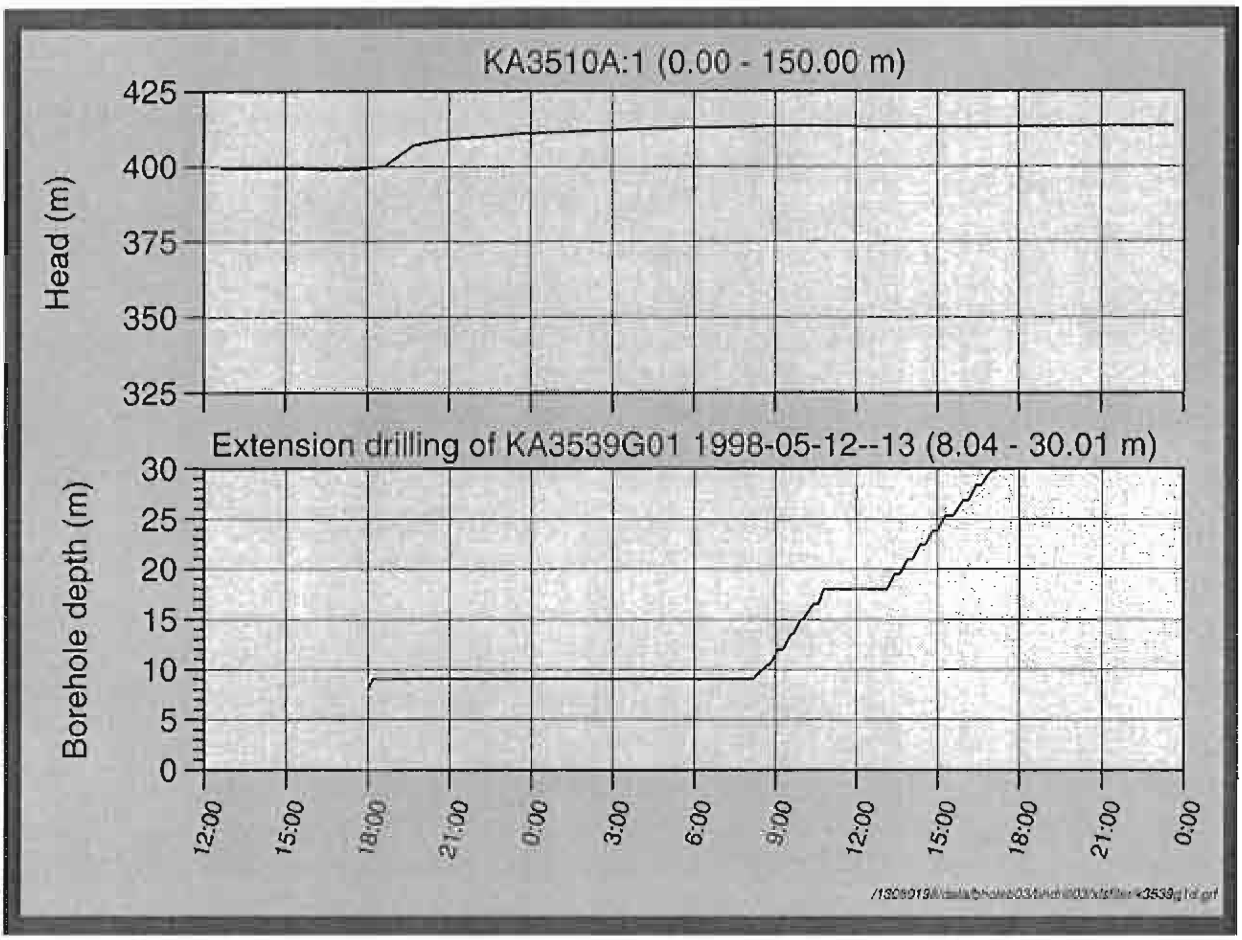


KA3548G01
Head (m)
250
225
200
175
150
125
100
75
50
KA3546G01
Head (m)
200
175
150
125
100
75
50
KA3550G01
Head (m)
250
225
200
175
150
125
100
KA3551G
Head (m)
10
8
6
4
2
0
Extension drilling of KA3539G01 1998-05-12--13 (8.04 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
15:00
18:00
21:00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00


KA3546G01
Head (m)
300
275
250
225
200
175
150
125
100
KA3545G01
Head (m)
250
225
200
175
150
125
100
KA3552G01
Head (m)
150
125
100
75
50
Extension drilling of KA3539G01 1998-05-12--13 (8.04 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
15:00
18:00
21:00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00

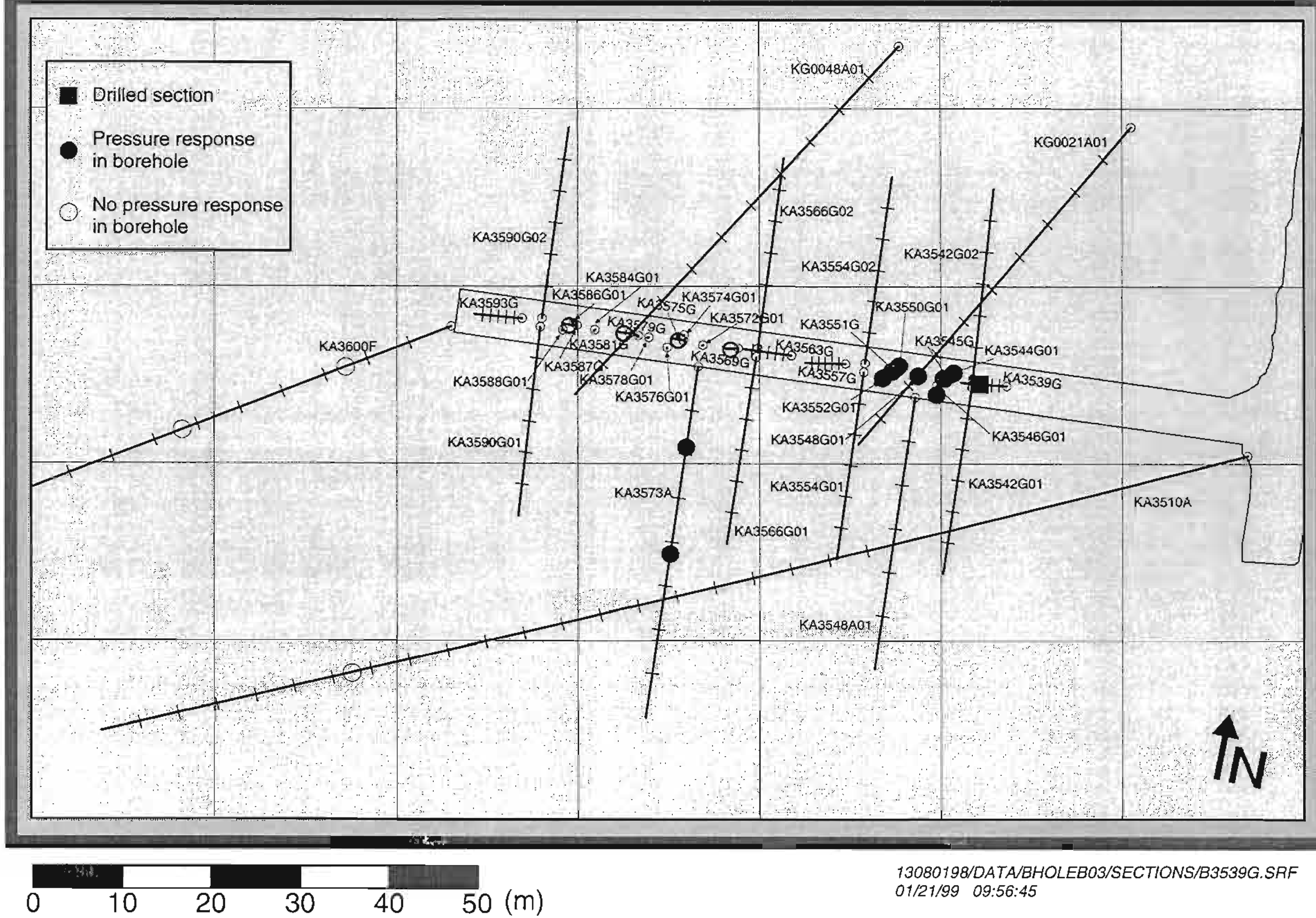


KA3573A:1 (18.00 - 40.00 m)
KA3573A:1 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:1 (4.50 - 21.00 m)
Head (m)
425
400
375
350
325
Extension drilling of KA3539G01 1998-05-12--13 (8.04 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
15:00
18:00
21:00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00



KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Extension drilling of KA3539G01 1998-05-12--13 (8.04 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
15:00
18:00
21:00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00

ÄSPÖ HARD ROCK LABORATORY
Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b
Pressure responses during drilling of KA3539G.



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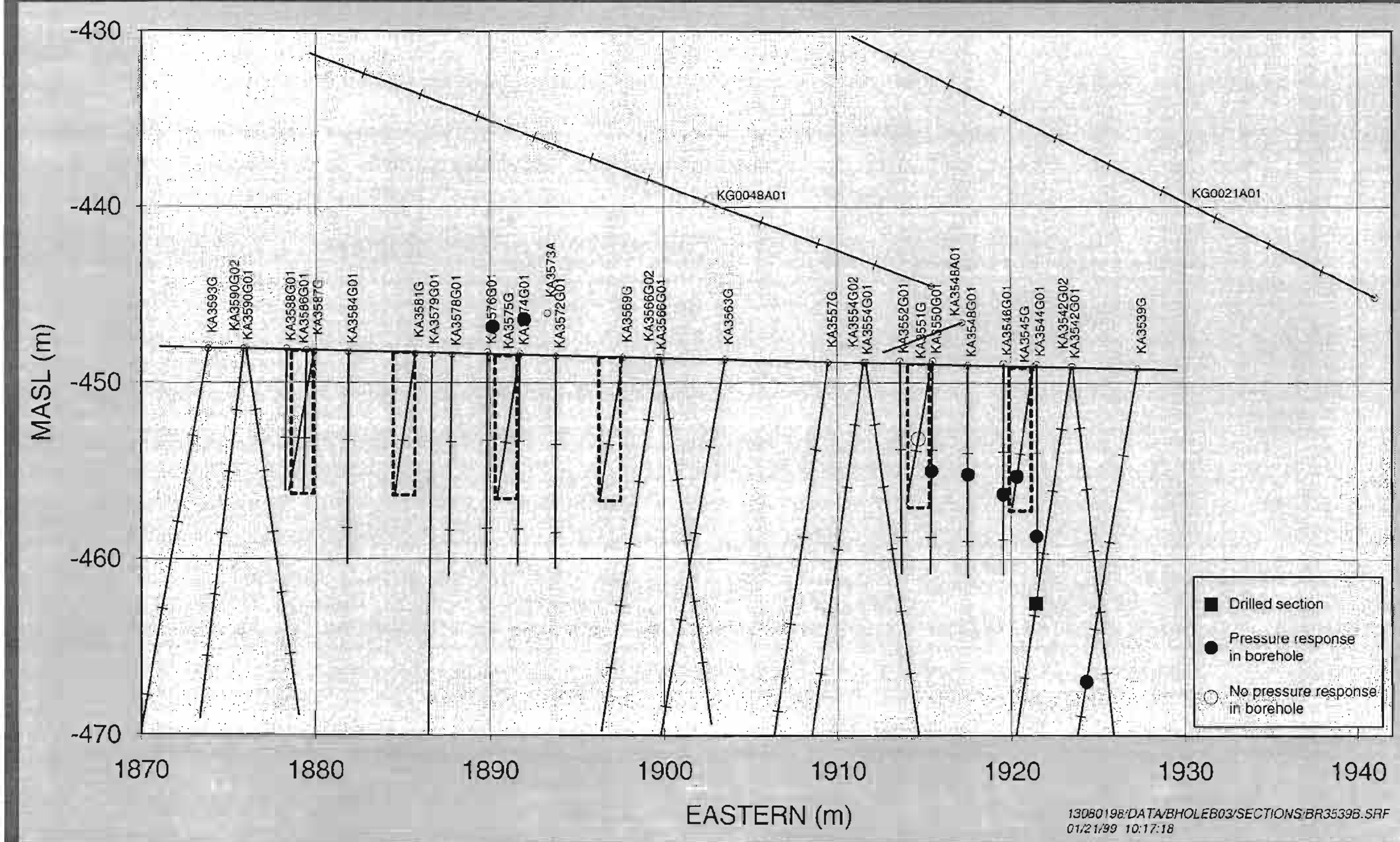
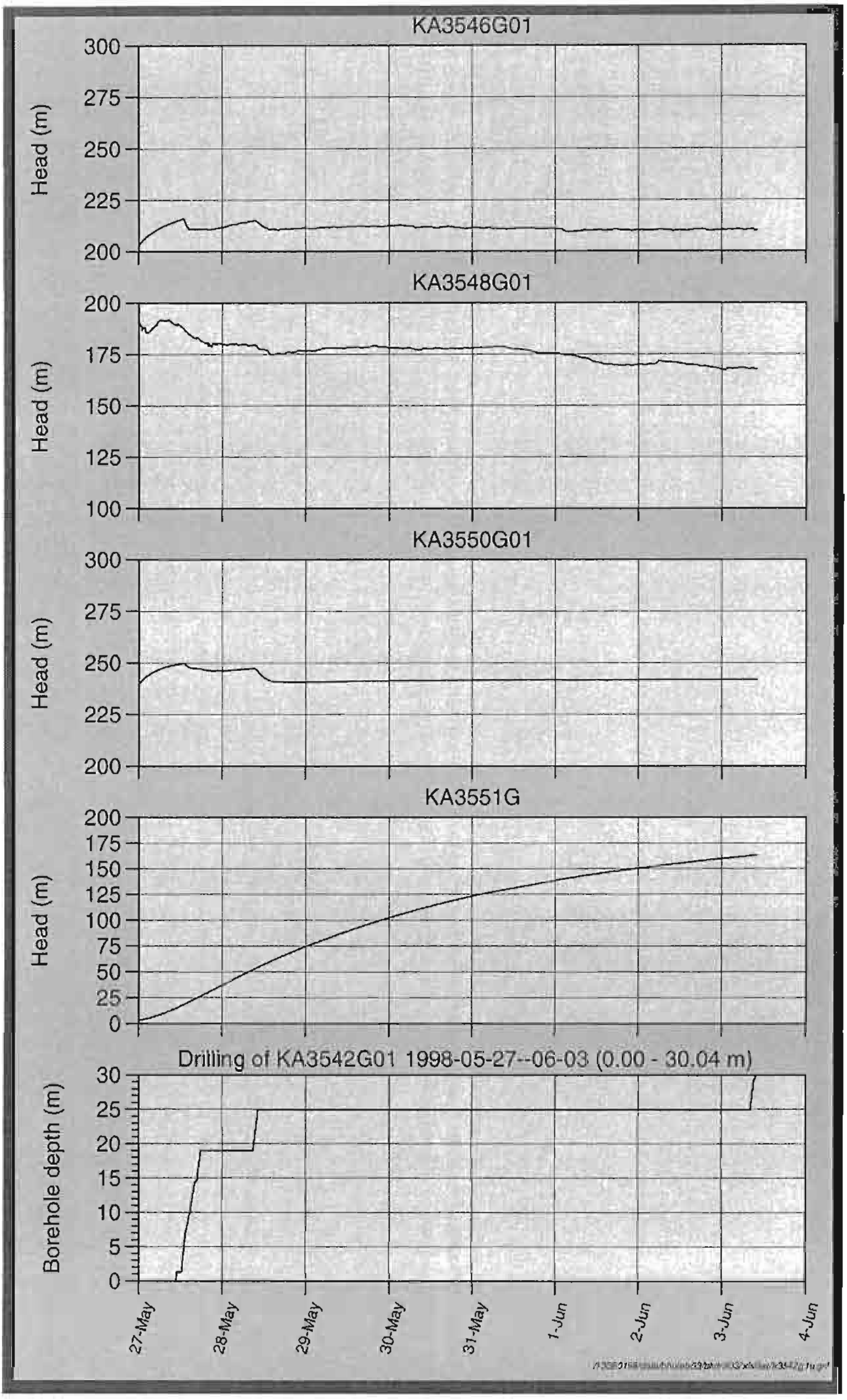
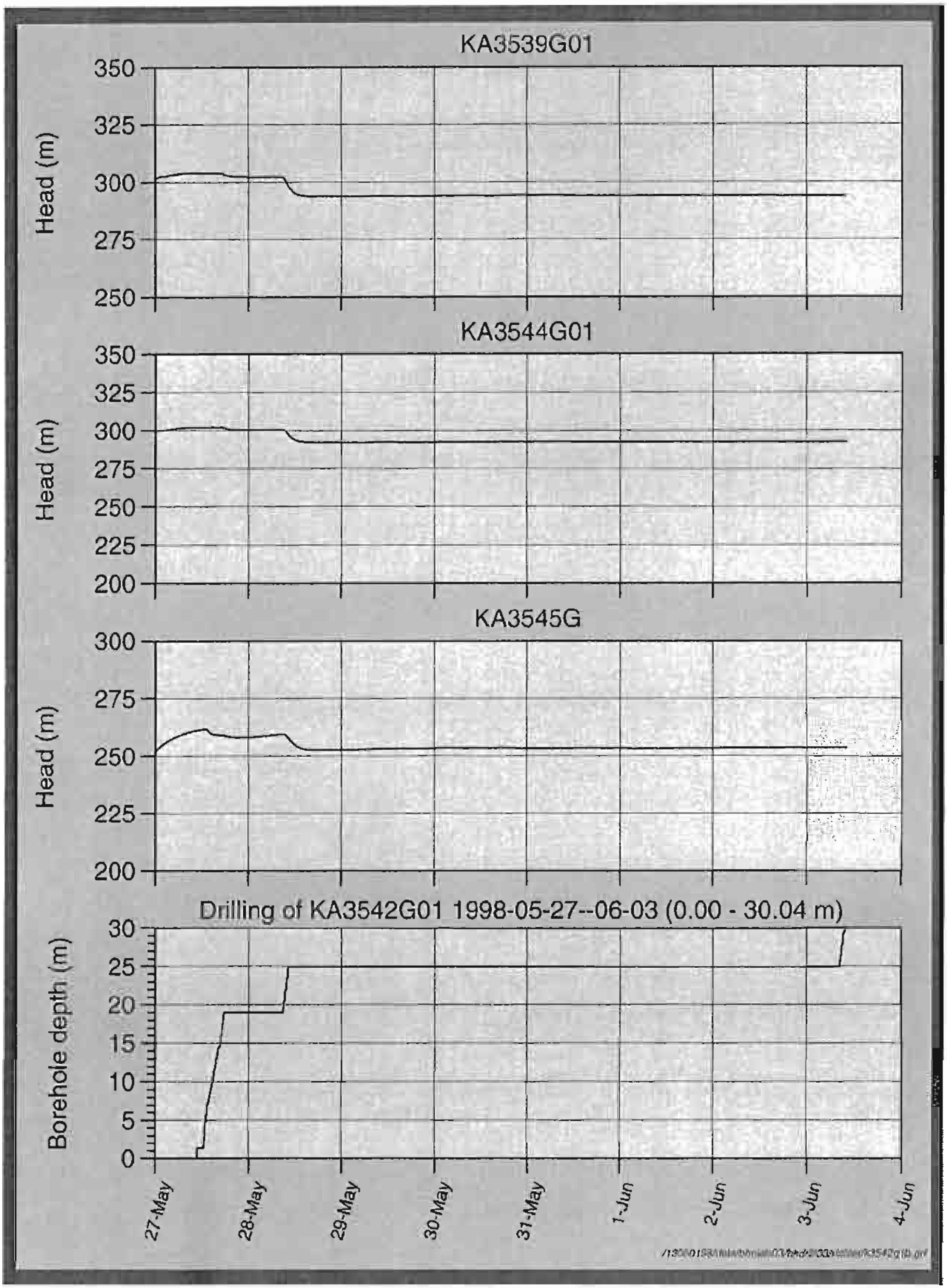
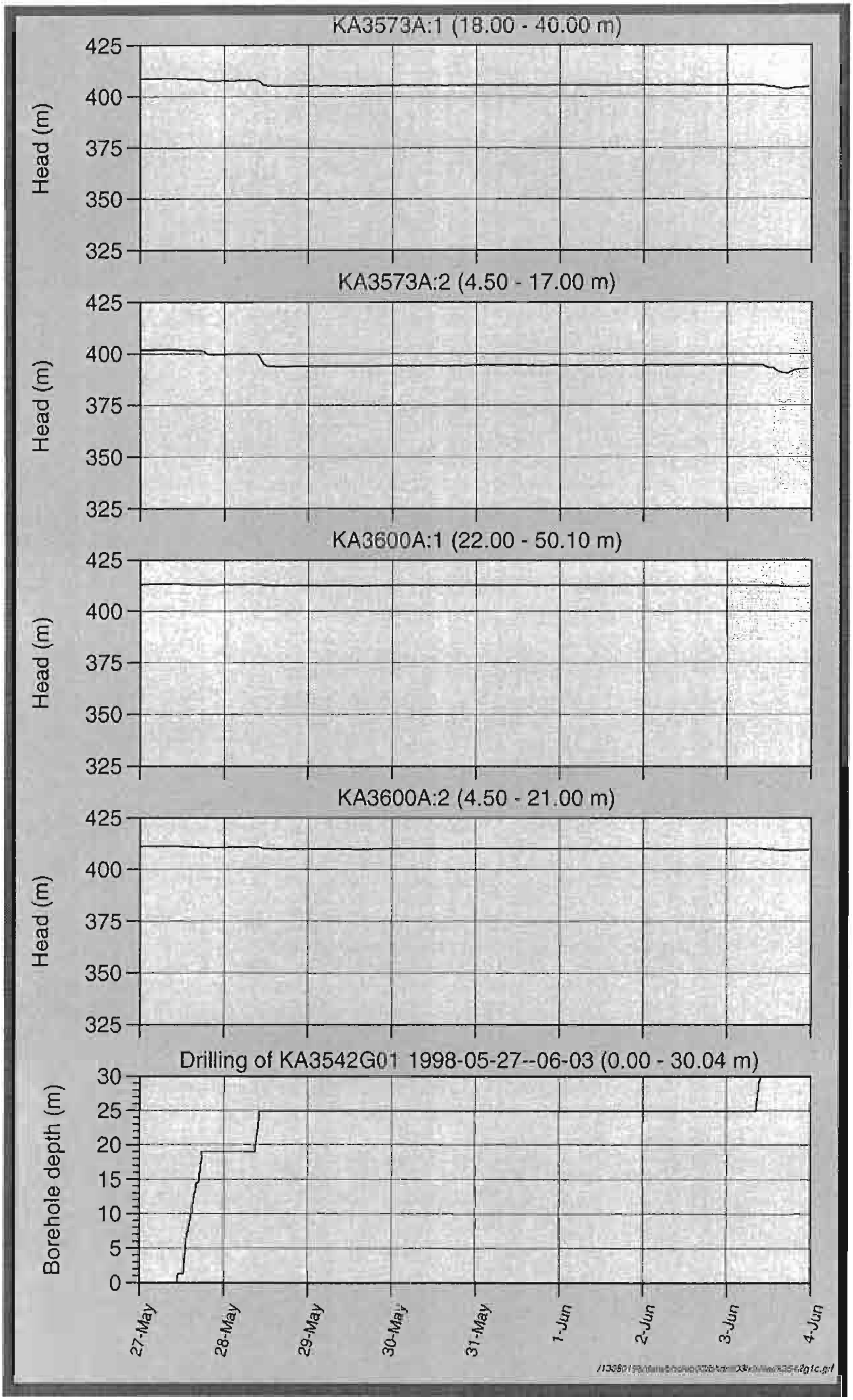
01/21/99 09:56:45

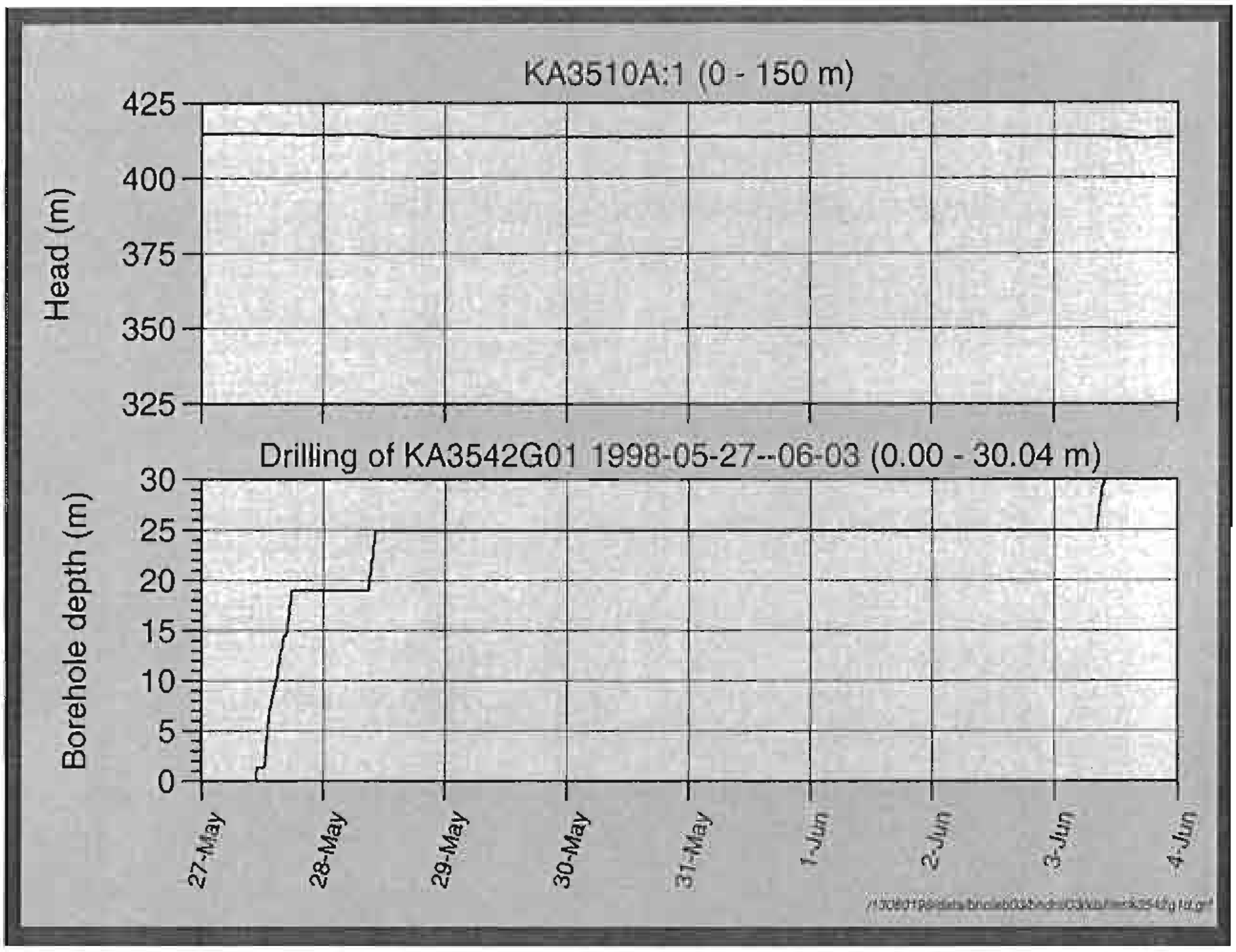
ÄSPÖ HARD ROCK LABORATORY
Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b.
Drilling responses when drilling KA3539G




KA3546G01
Head (m)
300
275
250
225
200
KA3548G01
Head (m)
200
175
150
125
100
KA3550G01
Head (m)
300
275
250
225
200
KA3551G
Head (m)
200
175
150
125
100
75
50
25
0
Drilling of KA3542G01 1998-05-27--06-03 (0.00 - 30.04 m)
Borehole depth (m)
30
25
20
15
10
5
0
27-May
28-May
29-May
30-May
31-May
1-Jun
2-Jun
3-Jun
4-Jun

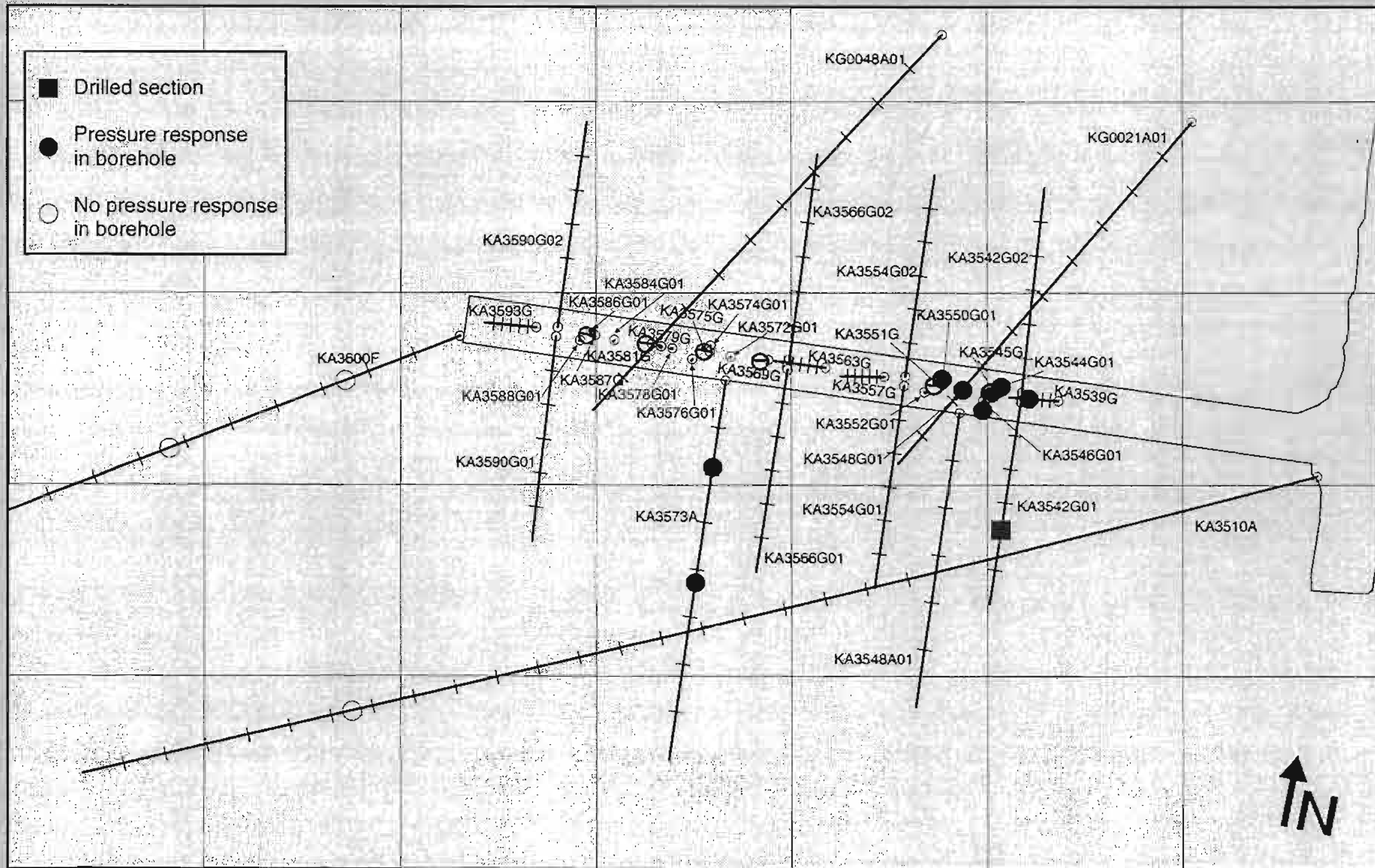

KA3539G01
Head (m)
350
325
300
275
250
KA3544G01
Head (m)
350
325
300
275
250
225
200
KA3545G
Head (m)
300
275
250
225
200
Drilling of KA3542G01 1998-05-27--06-03 (0.00 - 30.04 m)
Borehole depth (m)
30
25
20
15
10
5
0
27-May
28-May
29-May
30-May
31-May
1-Jun
2-Jun
3-Jun
4-Jun


KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Drilling of KA3542G01 1998-05-27--06-03 (0.00 - 30.04 m)
Head (m)
Borehole depth (m)
27-May
28-May
29-May
30-May
31-May
1-Jun
2-Jun
3-Jun
4-Jun



KA3510A:1 (0 - 150 m)
Head (m)
425
400
375
350
325
Drilling of KA3542G01 1998-05-27--06-03 (0.00 - 30.04 m)
Borehole depth (m)
30
25
20
15
10
5
0
27-May
28-May
29-May
30-May
31-May
1-Jun
2-Jun
3-Jun
4-Jun

ÄSPÖ HARD ROCK LABORATORY
Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b
Pressure responses during drilling of KA3542G01.



0 10 20 30 40 50 (m)

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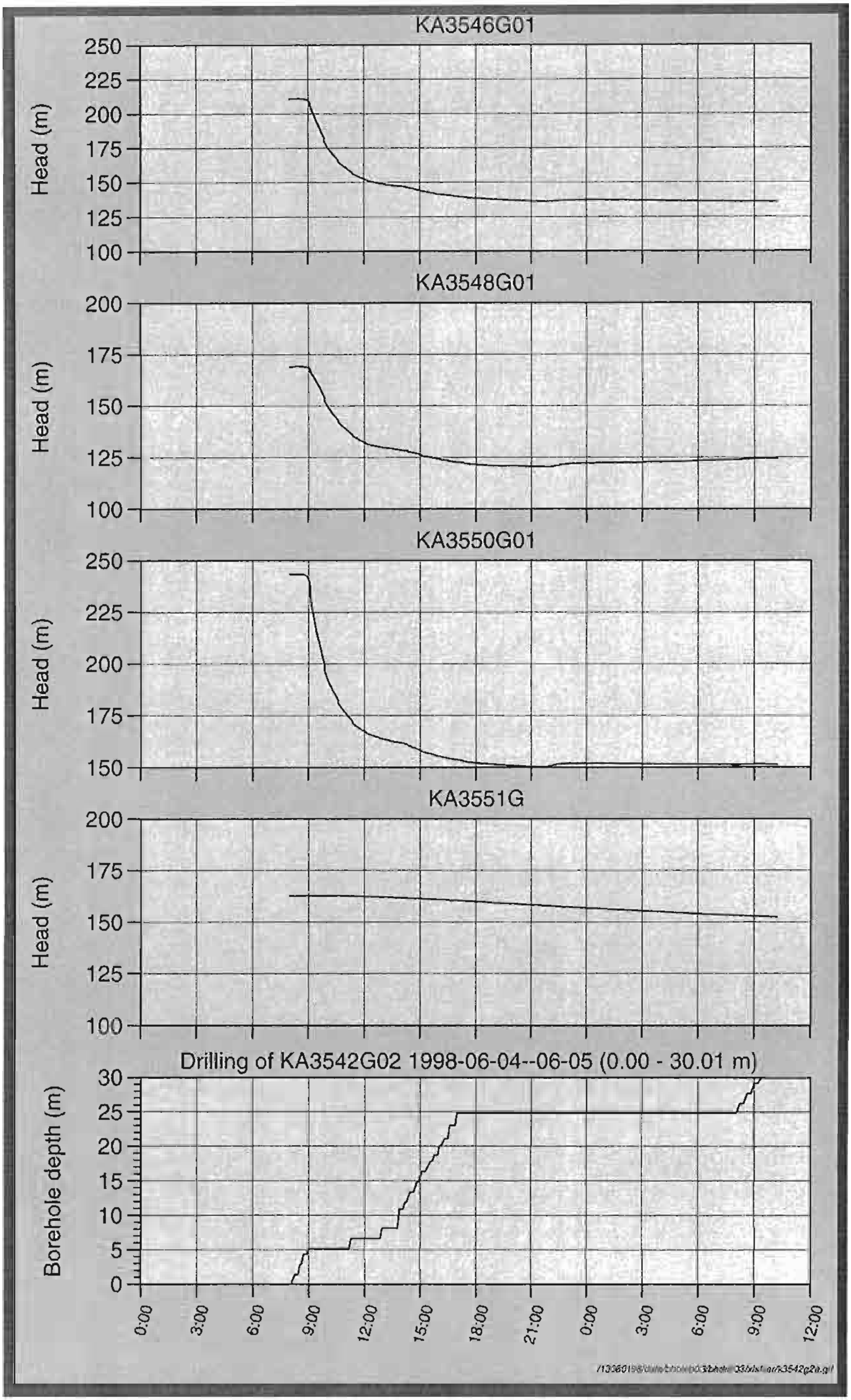
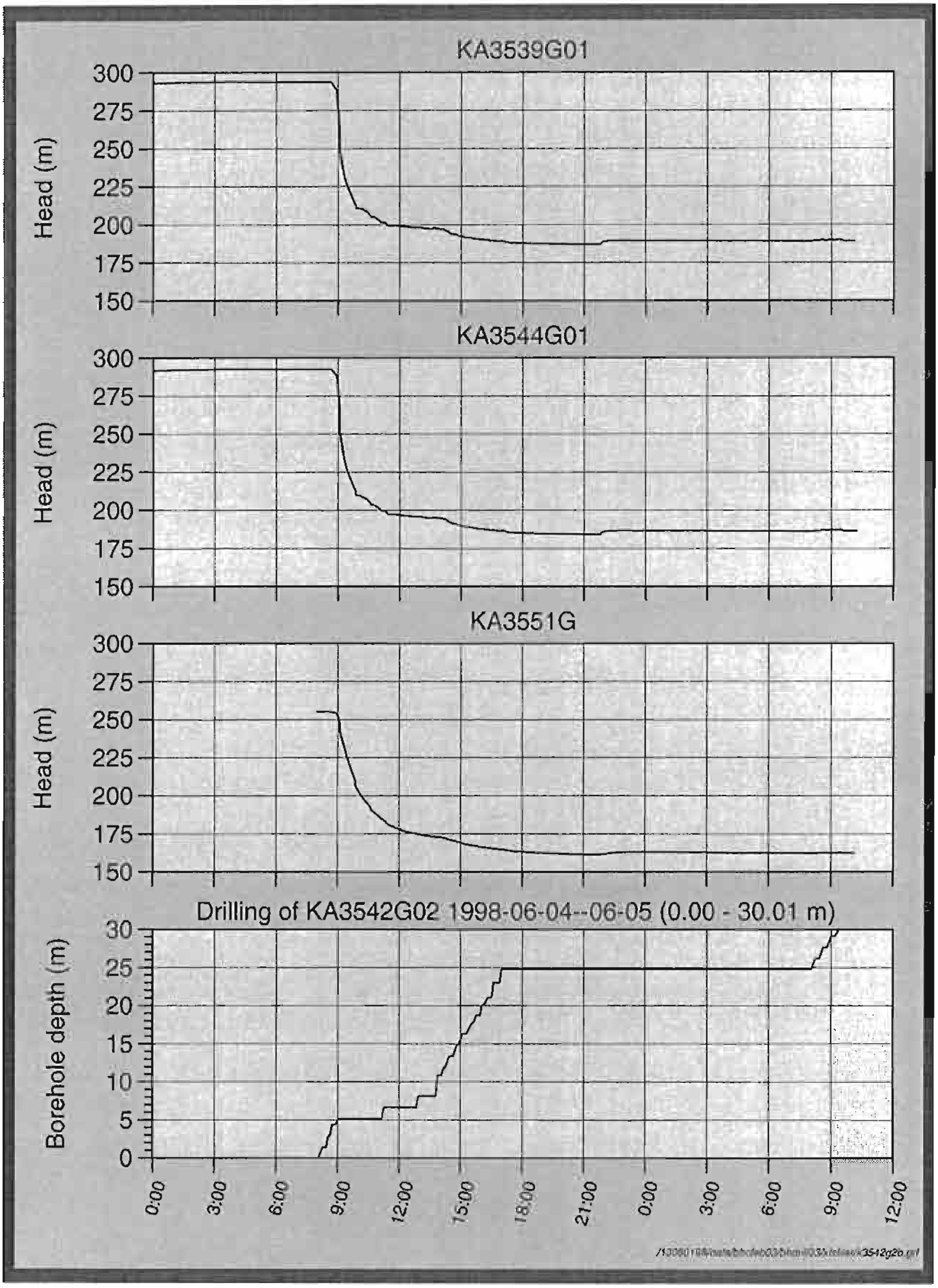
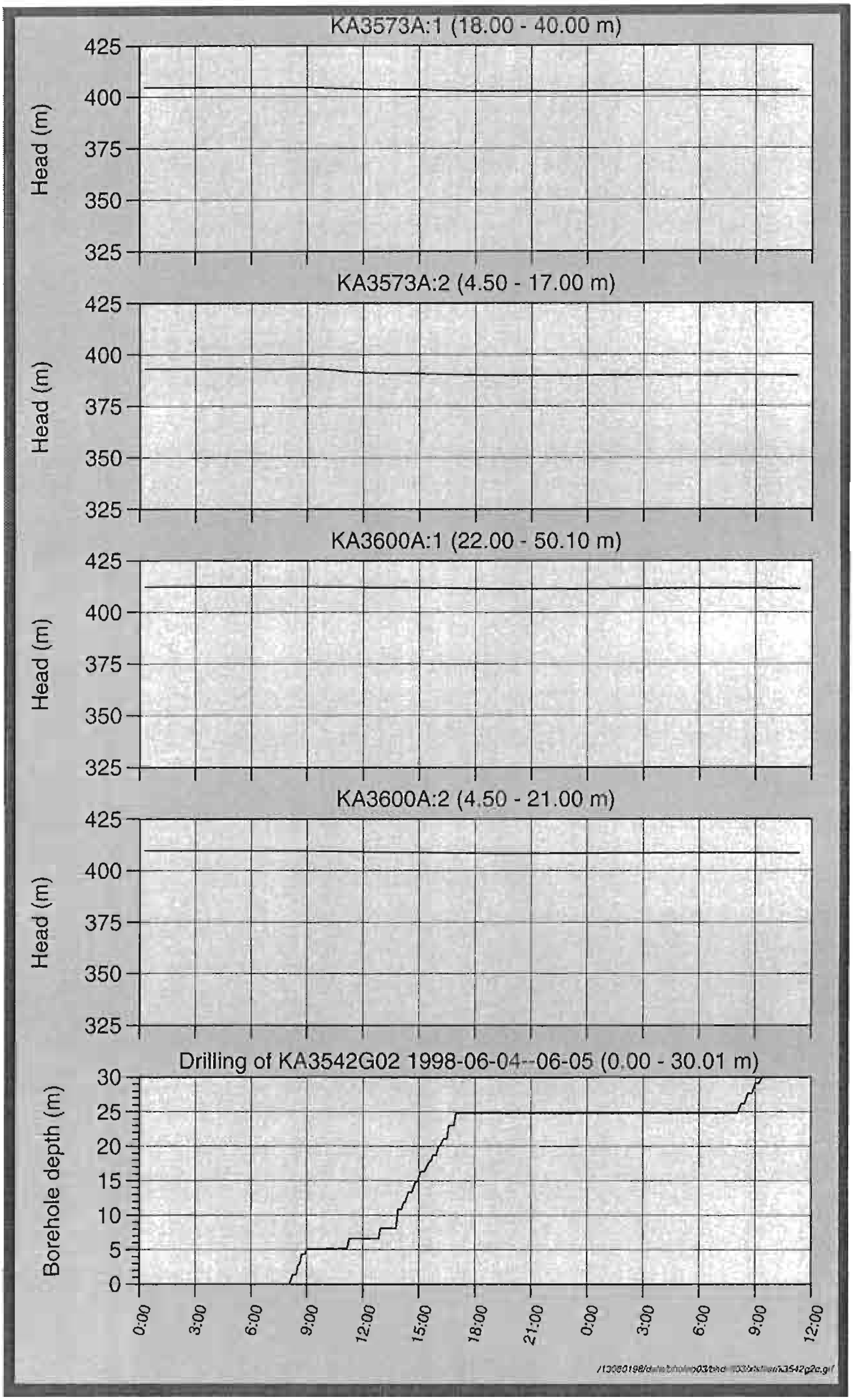
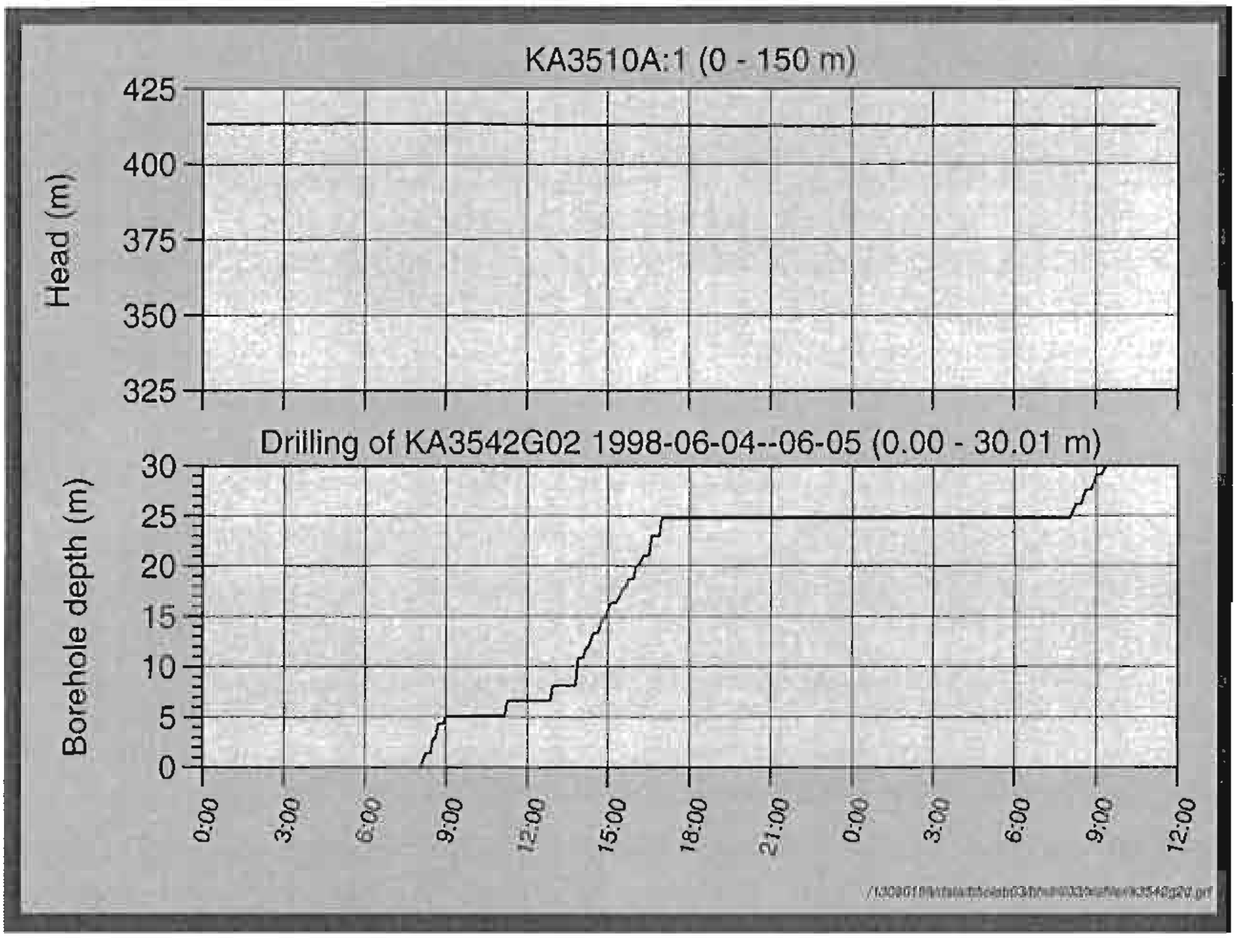

KA3546G01
Head (m)
250
225
200
175
150
125
100
KA3548G01
Head (m)
200
175
150
125
100
KA3550G01
Head (m)
250
225
200
175
150
KA3551G
Head (m)
200
175
150
125
100
Drilling of KA3542G02 1998-06-04--06-05 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
3:00
6:00
9:00
12:00


KA3539G01
Head (m)
300
275
250
225
200
175
150
KA3544G01
Head (m)
KA3551G
Drilling of KA3542G02 1998-06-04--06-05 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00


KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Drilling of KA3542G02 1998-06-04--06-05 (0.00 - 30.01 m)
Head (m)
Borehole depth (m)
425
400
375
350
325
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00



KA3510A:1 (0 - 150 m)
Head (m)
425
400
375
350
325
Drilling of KA3542G02 1998-06-04--06-05 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
3:00
6:00
9:00
12:00

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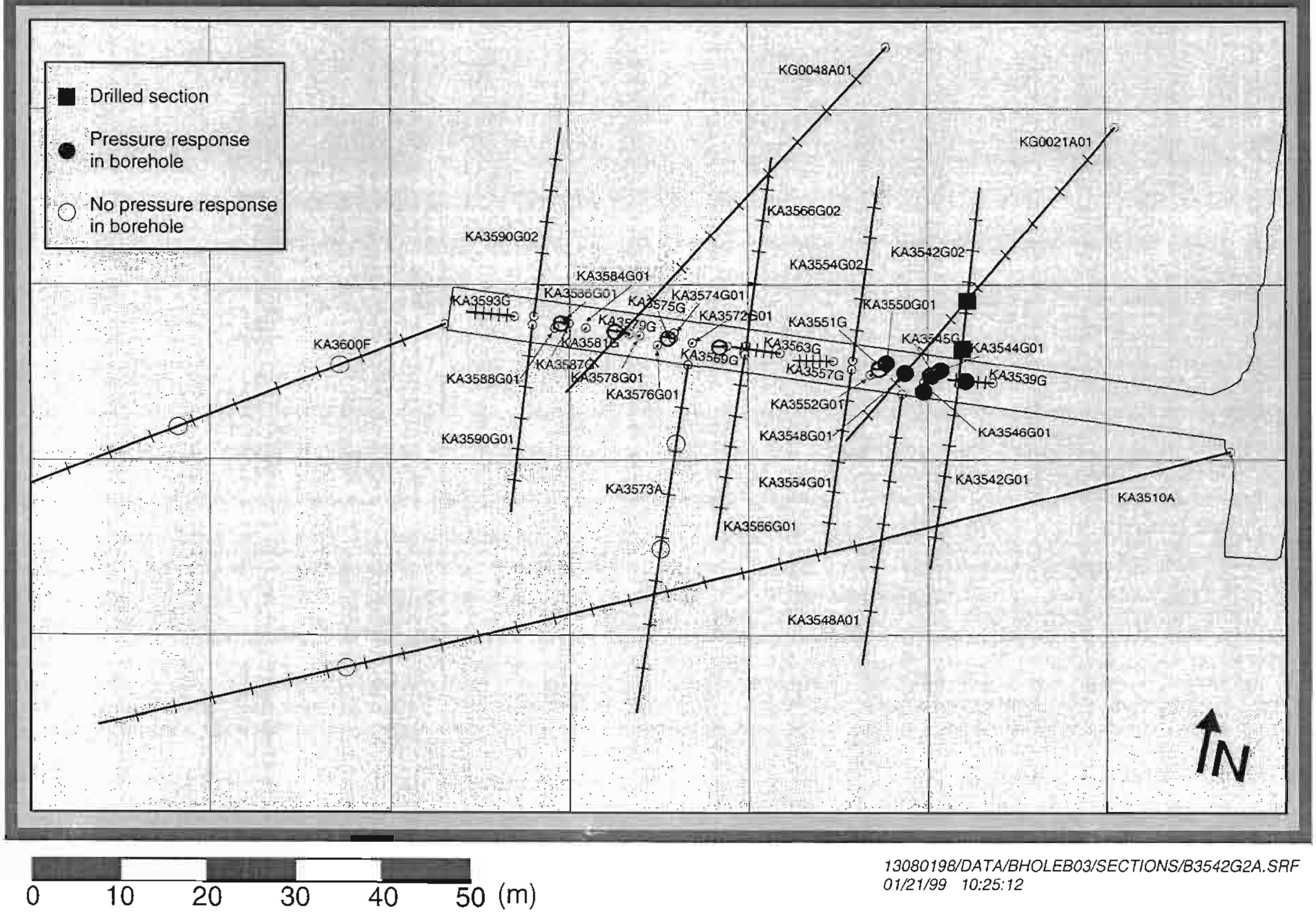
Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b
Pressure responses during drilling of KA3542G02.



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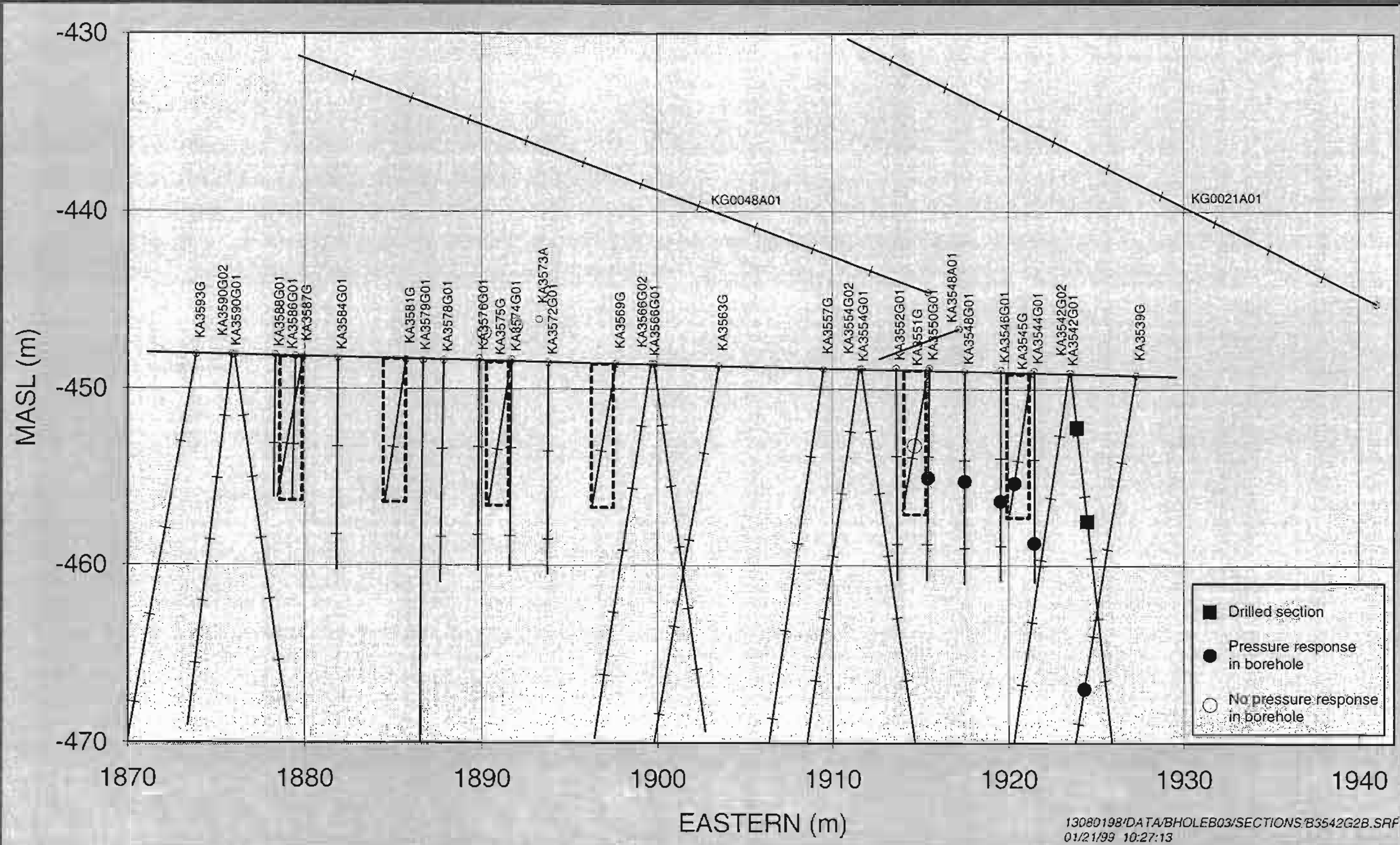
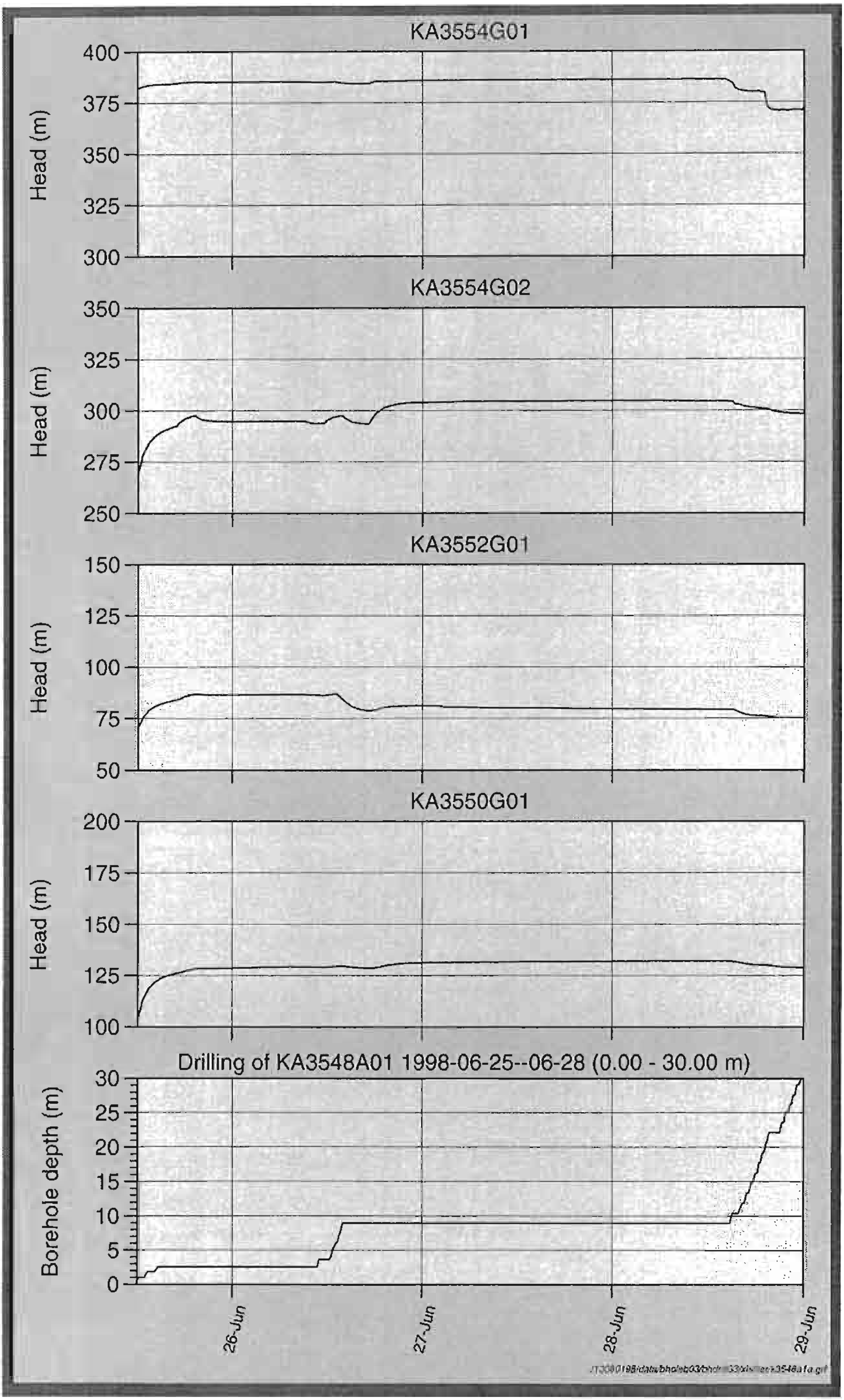
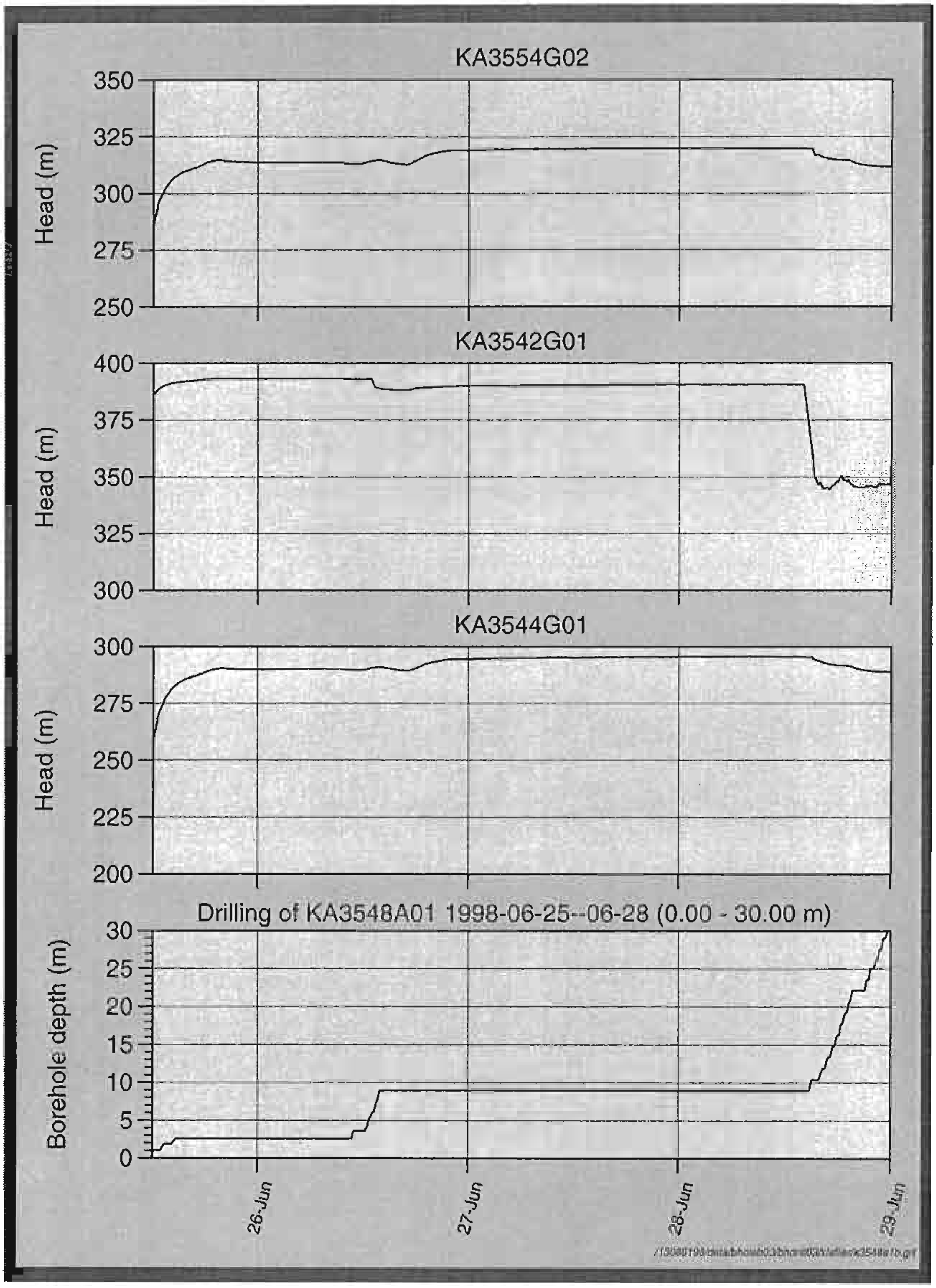
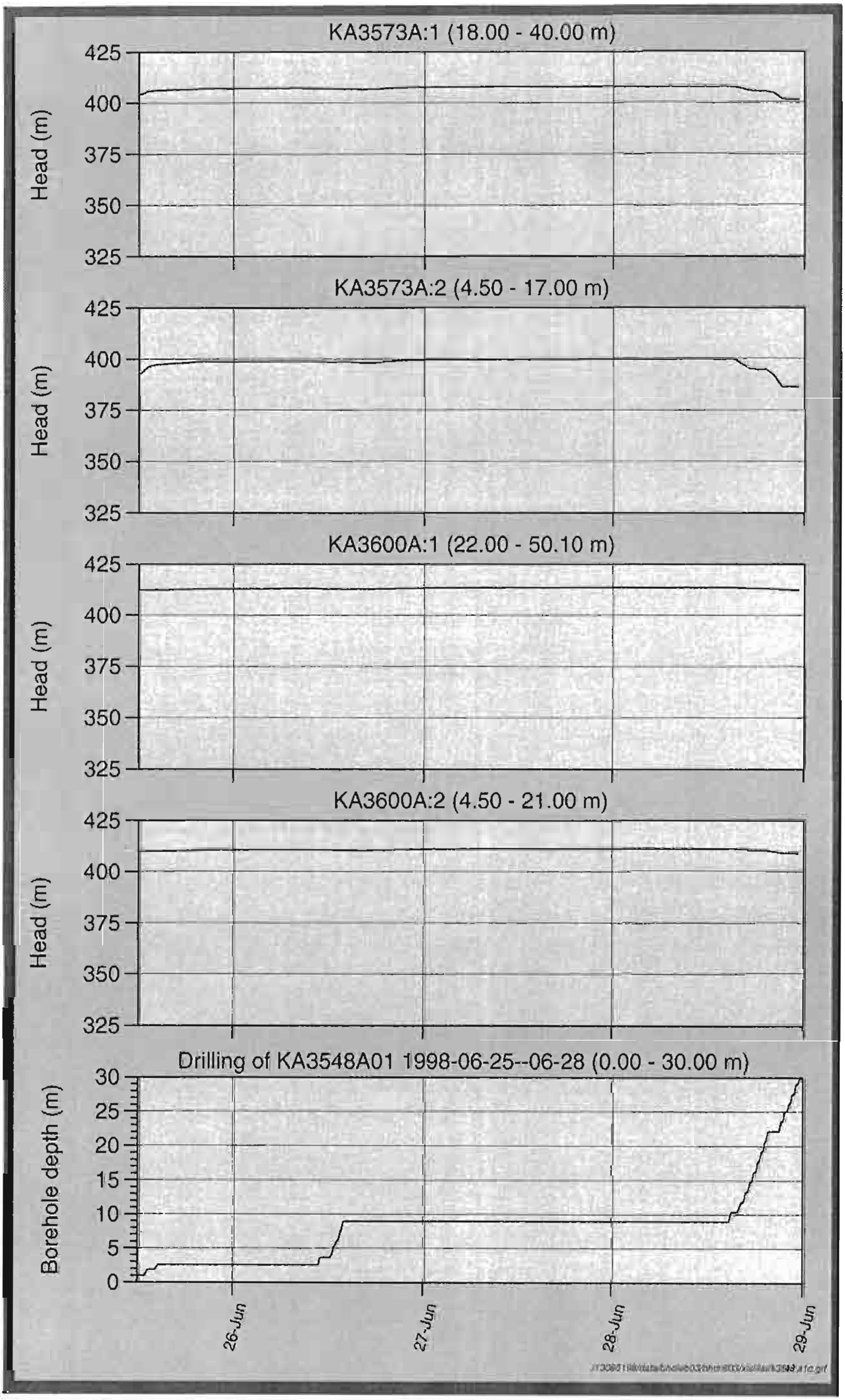
01/21/99 10:25:12

ÄSPÖ HARD ROCK LABORATORY
Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b.
Drilling responses when drilling KA3542G02.




KA3554G01
Head (m)
400
375
350
325
300
KA3554G02
Head (m)
350
325
300
275
250
KA3552G01
Head (m)
150
125
100
75
50
KA3550G01
Head (m)
200
175
150
125
100
Drilling of KA3548A01 1998-06-25--06-28 (0.00 - 30.00 m)
Borehole depth (m)
30
25
20
15
10
5
0
26-Jun
27-Jun
28-Jun
29-Jun


KA3554G02
Head (m)
350
325
300
275
250
KA3542G01
Head (m)
400
375
350
325
300
KA3544G01
Head (m)
300
275
250
225
200
Drilling of KA3548A01 1998-06-25--06-28 (0.00 - 30.00 m)
Borehole depth (m)
30
25
20
15
10
5
0
26-Jun
27-Jun
28-Jun
29-Jun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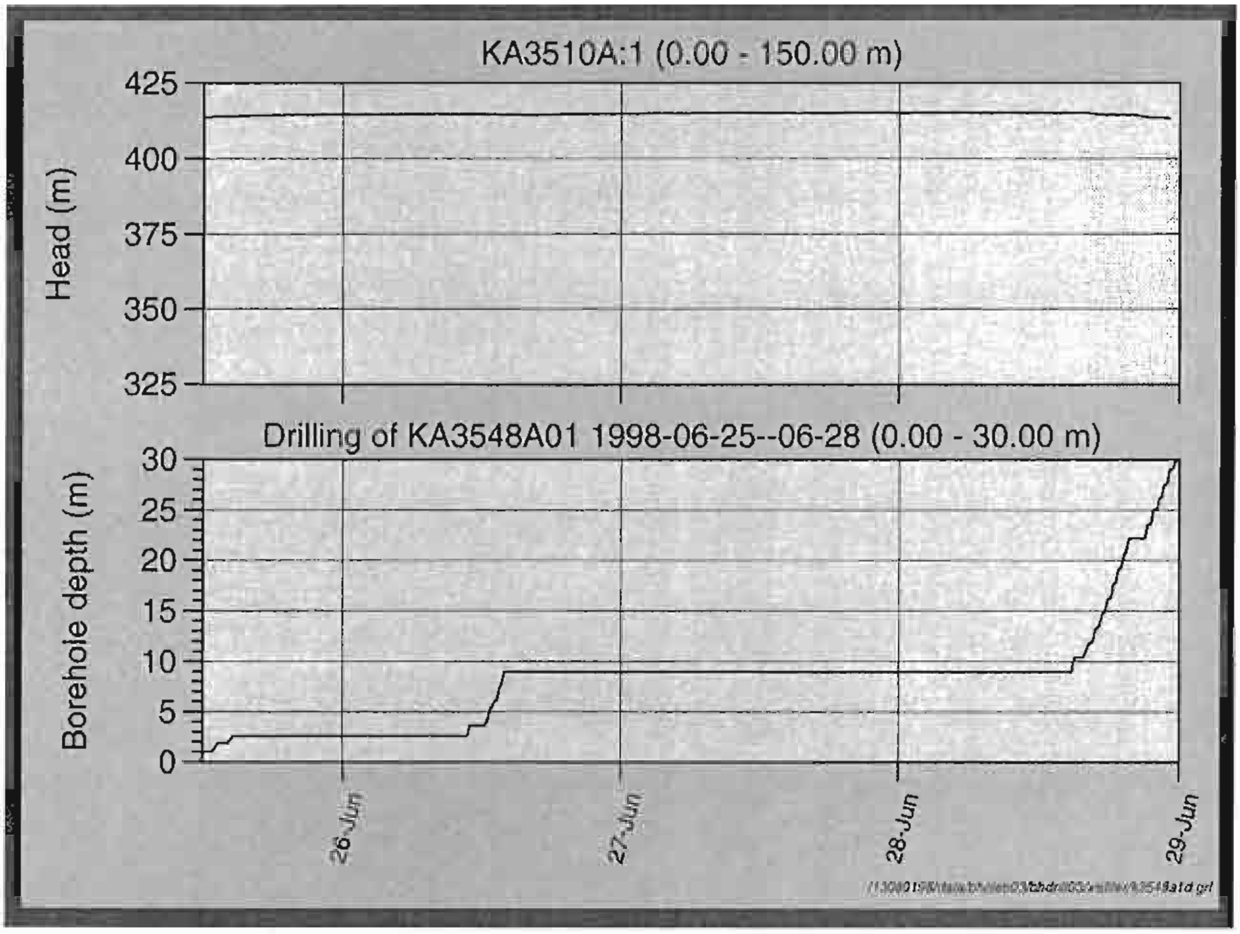
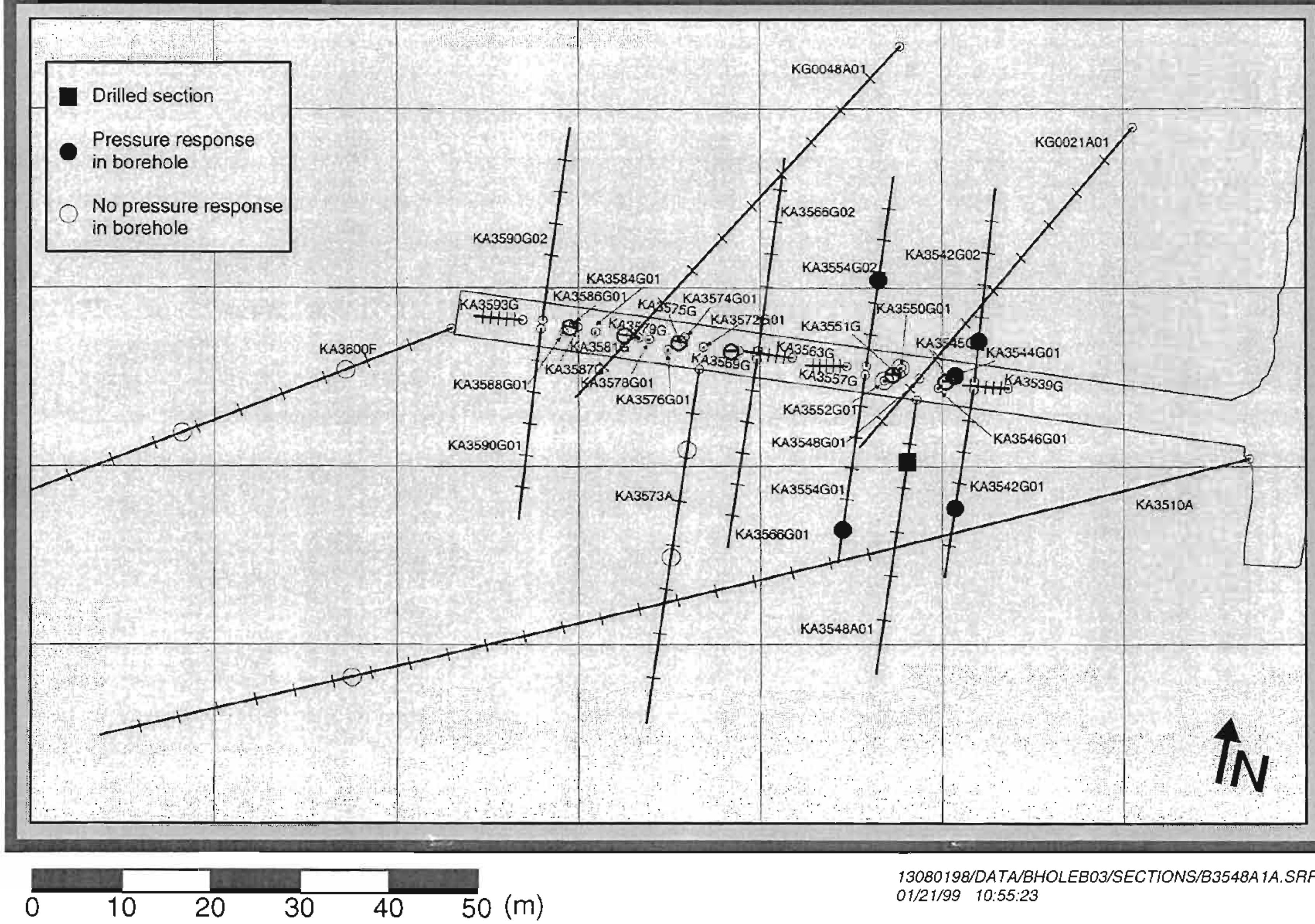
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3548A01 1998-06-25--06-28 (0.00 - 30.00 m)
Borehole depth (m)
30
25
20
15
10
5
0
26-Jun
27-Jun
28-Jun
29-Jun


KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3548A01 1998-06-25--06-28 (0.00 - 30.00 m)
Borehole depth (m)
30
25
20
15
10
5
0
26-Jun
27-Jun
28-Jun
29-Jun

ÄSPÖ HARD ROCK LABORATORY

Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b
Pressure responses during drilling of KA3548A01.



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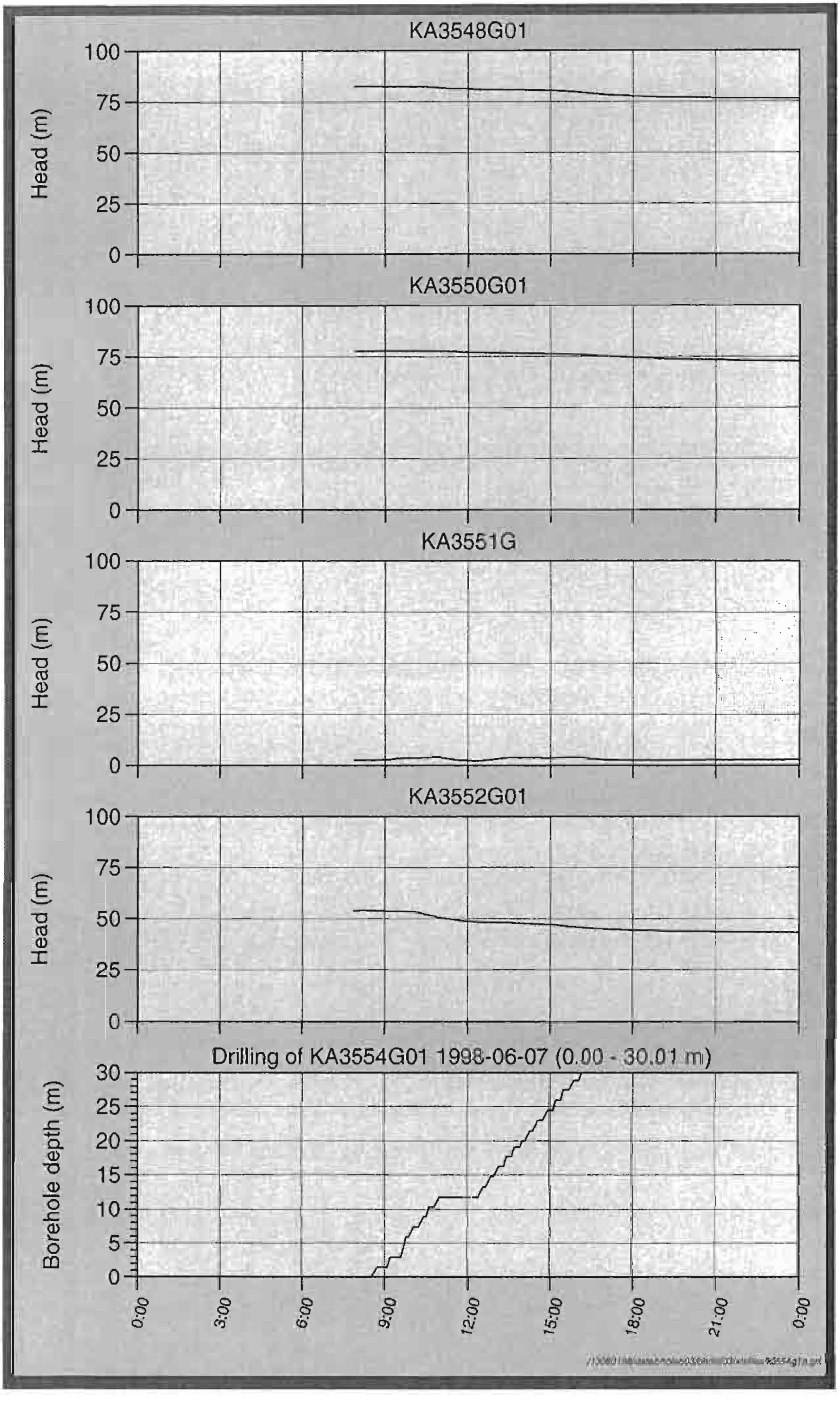
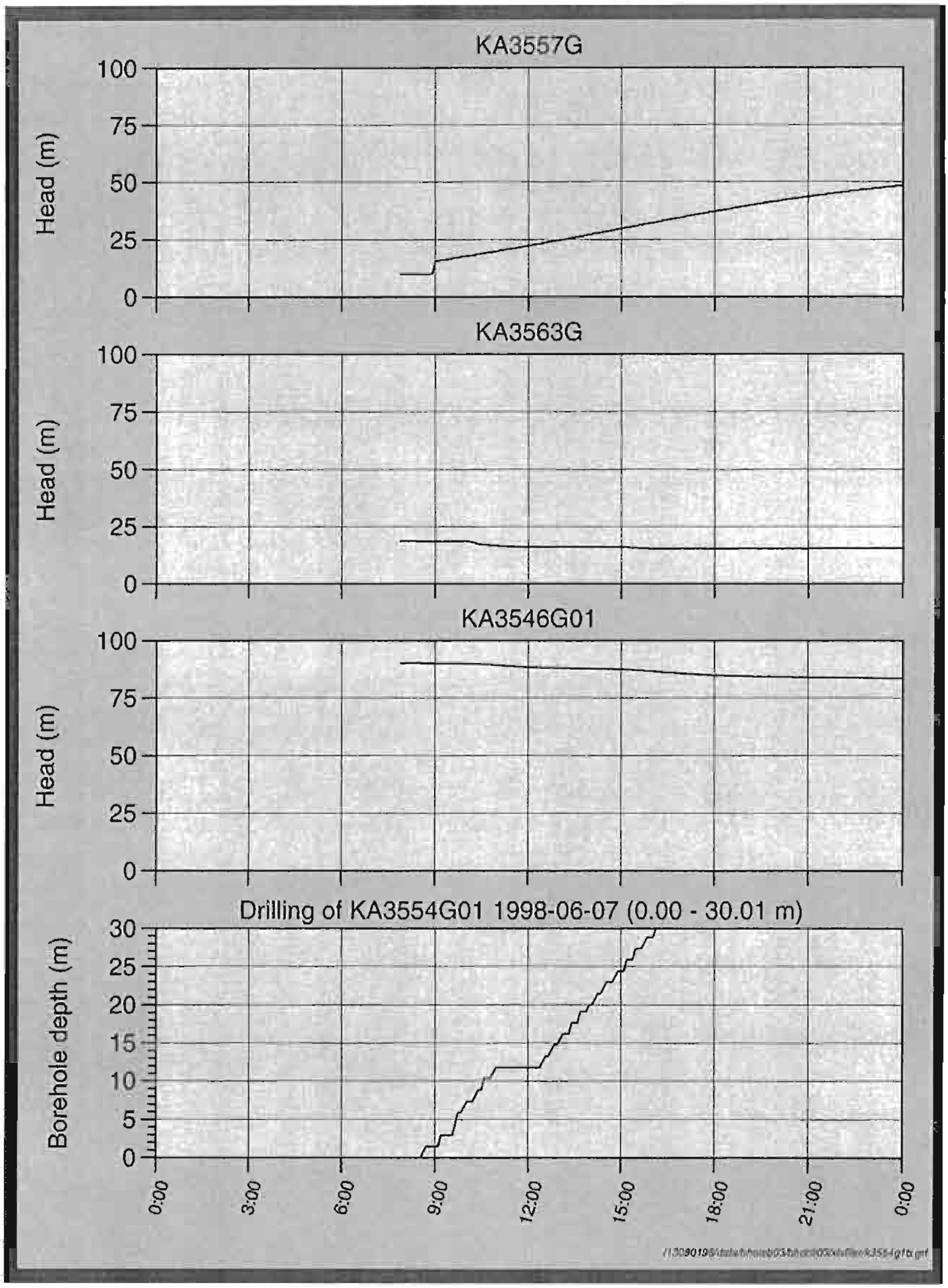
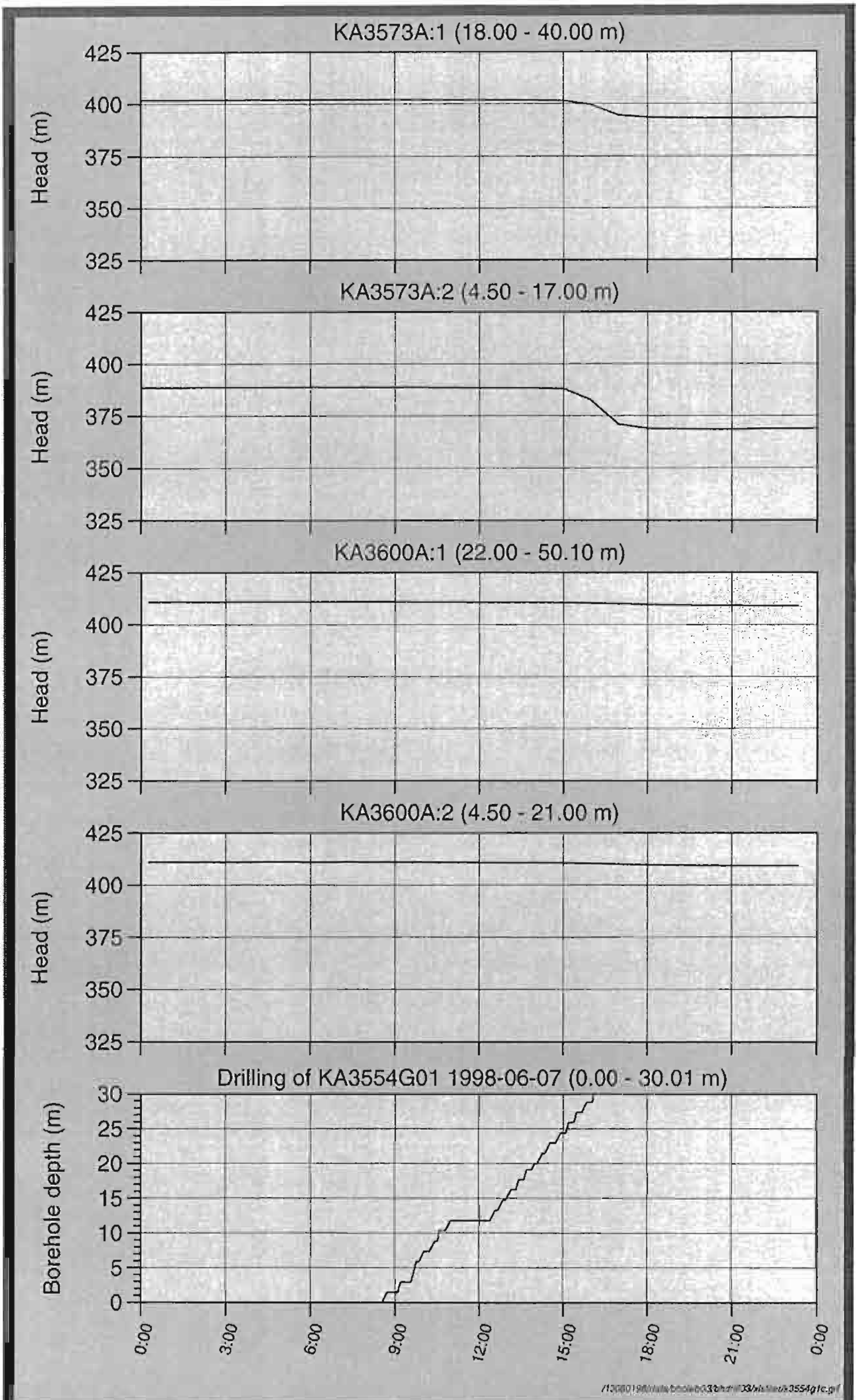
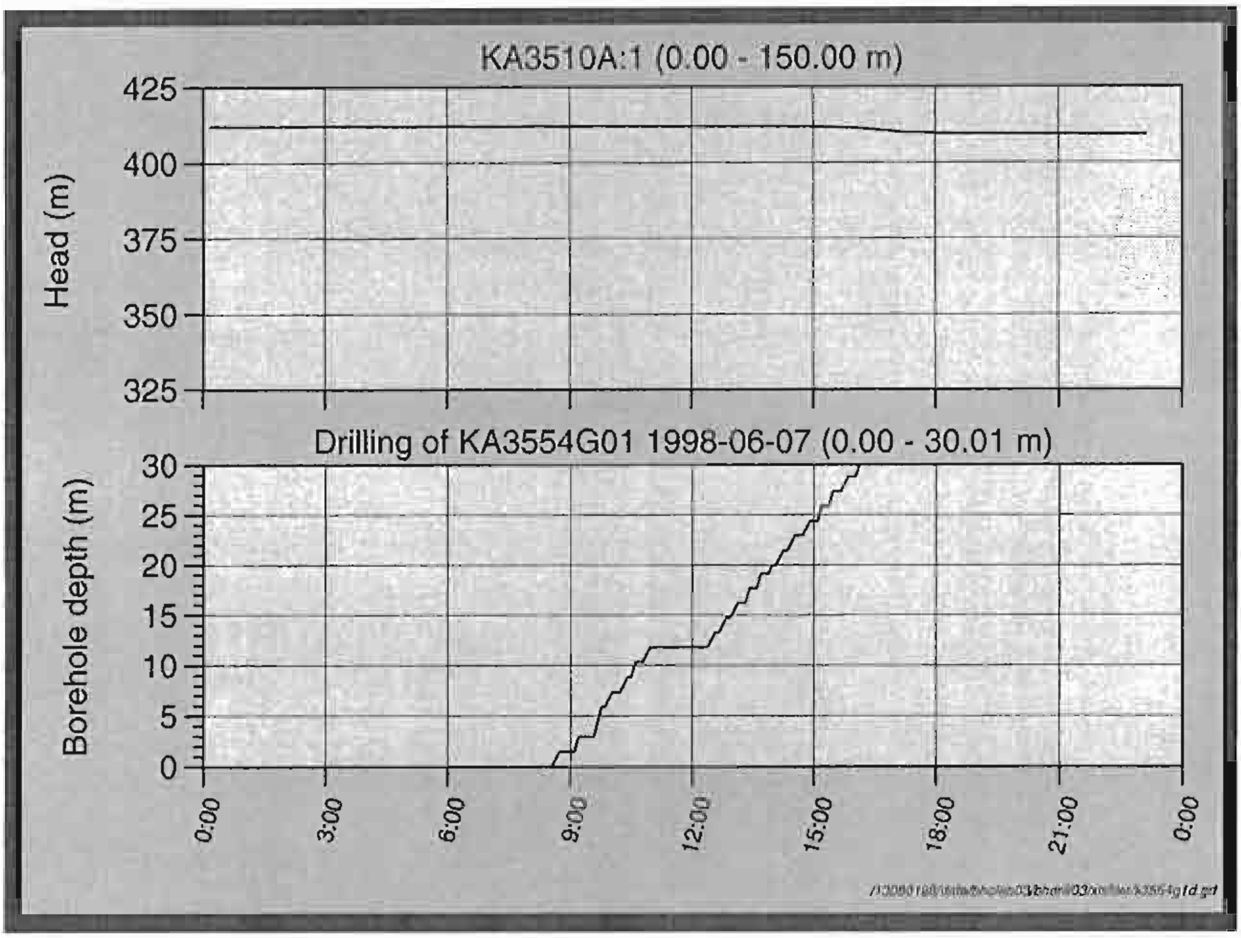
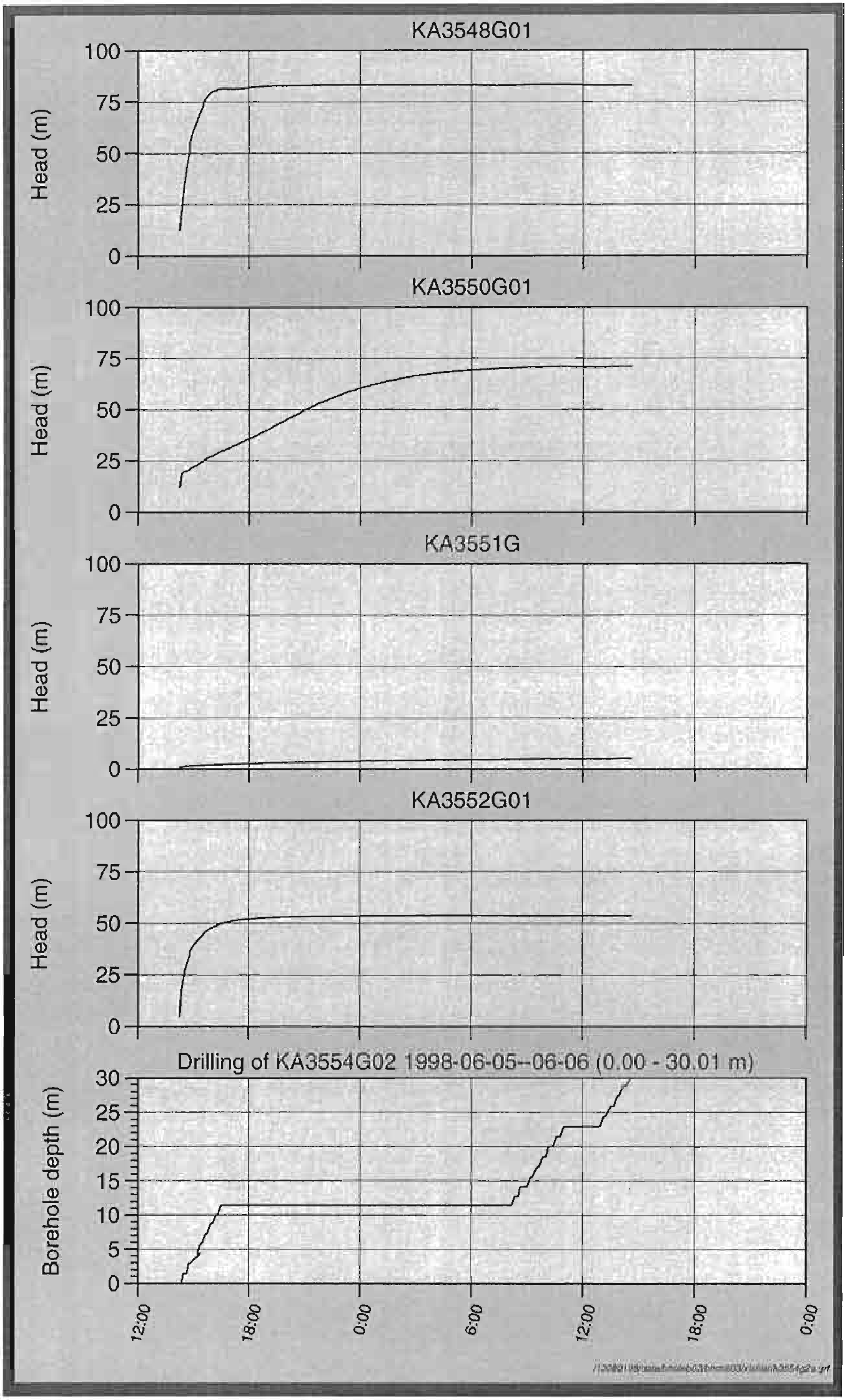

KA3548G01
Head (m)
100
75
50
25
0
KA3550G01
Head (m)
100
75
50
25
0
KA3551G
Head (m)
100
75
50
25
0
KA3552G01
Head (m)
100
75
50
25
0
Drilling of KA3554G01 1998-06-07 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00

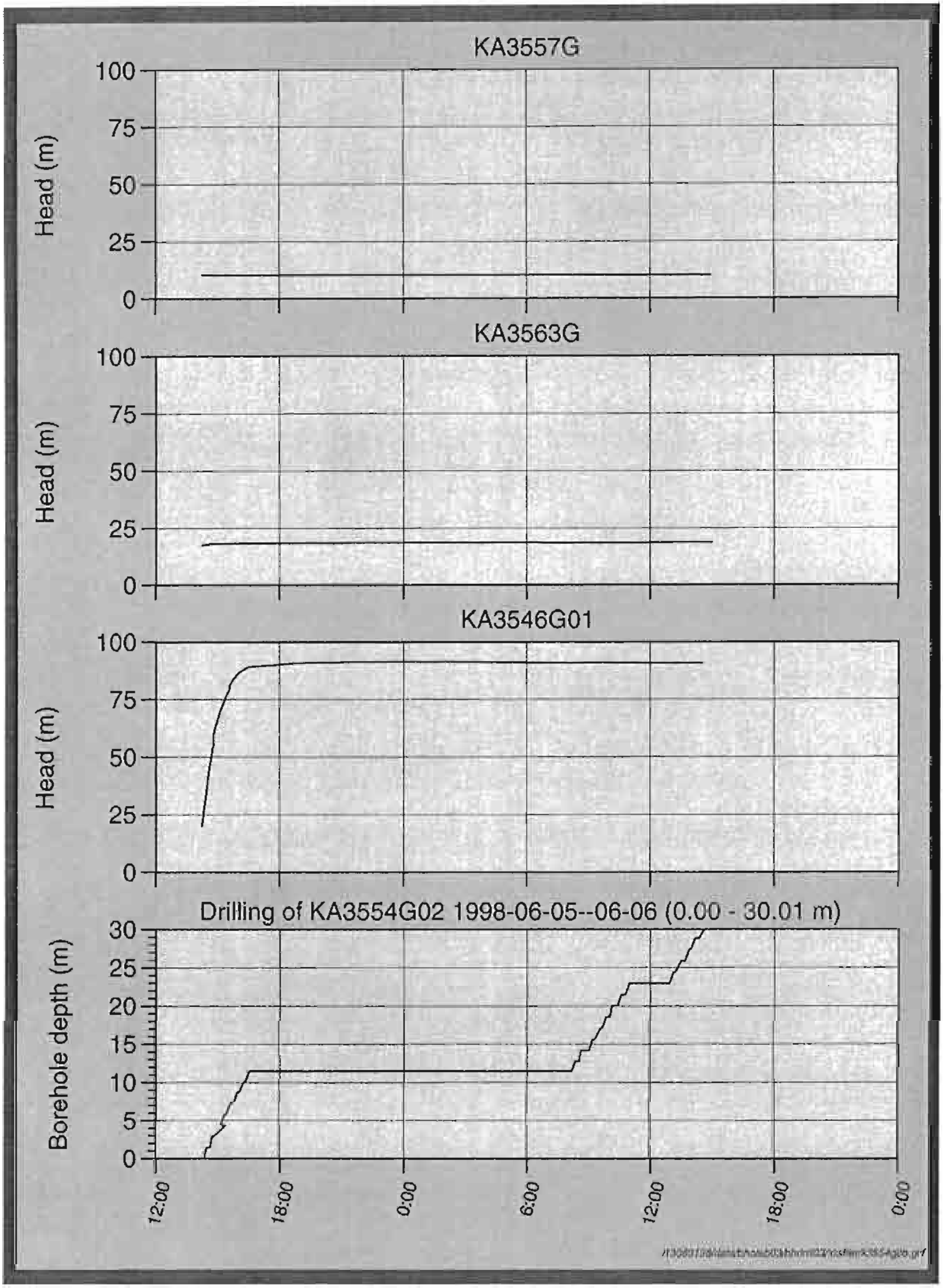

KA3557G
Head (m)
100
75
50
25
0
KA3563G
Head (m)
100
75
50
25
0
KA3546G01
Head (m)
100
75
50
25
0
Drilling of KA3554G01 1998-06-07 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00

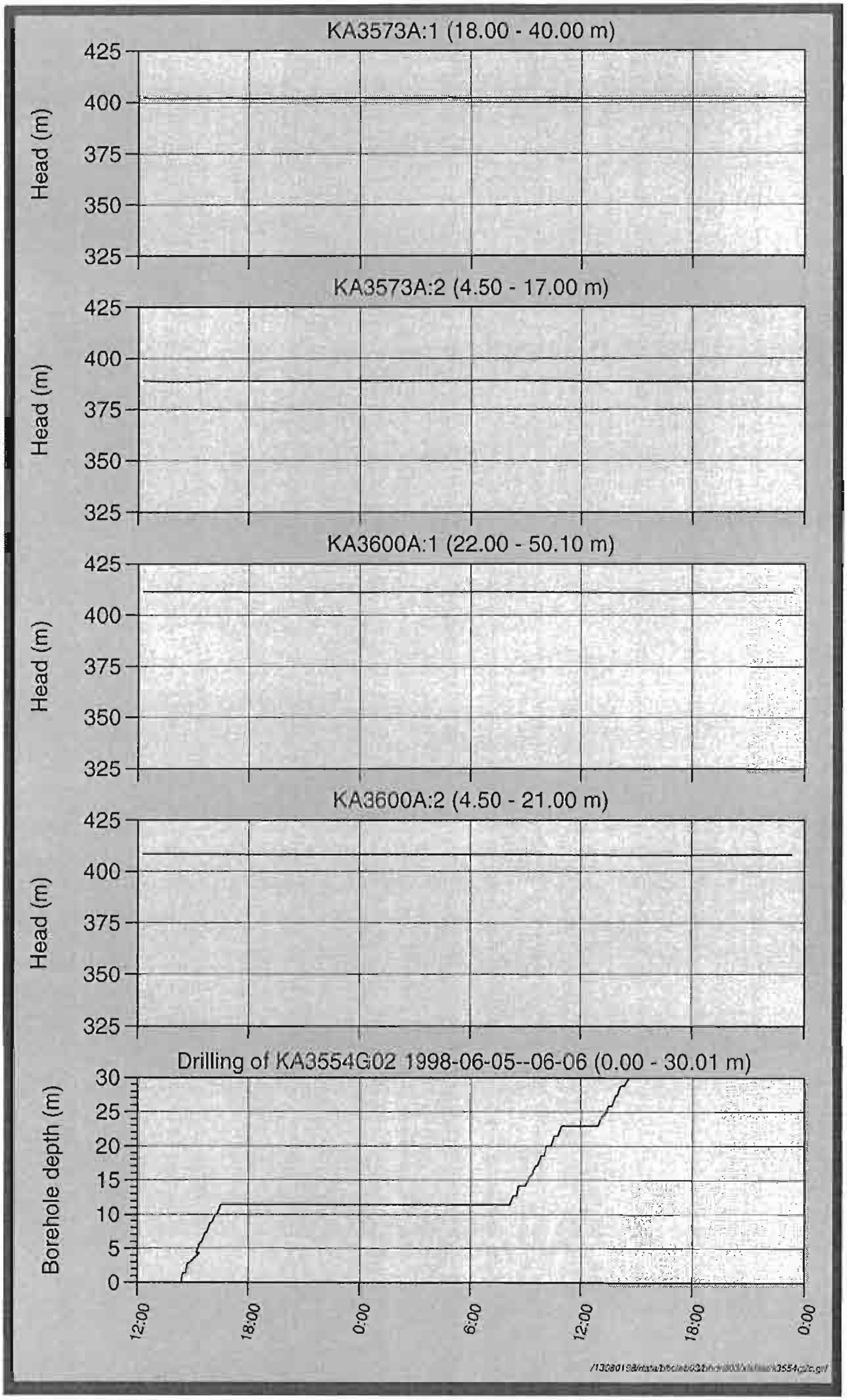


KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Drilling of KA3554G01 1998-06-07 (0.00 - 30.01 m)
Head (m)
Borehole depth (m)
425
400
375
350
325
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00

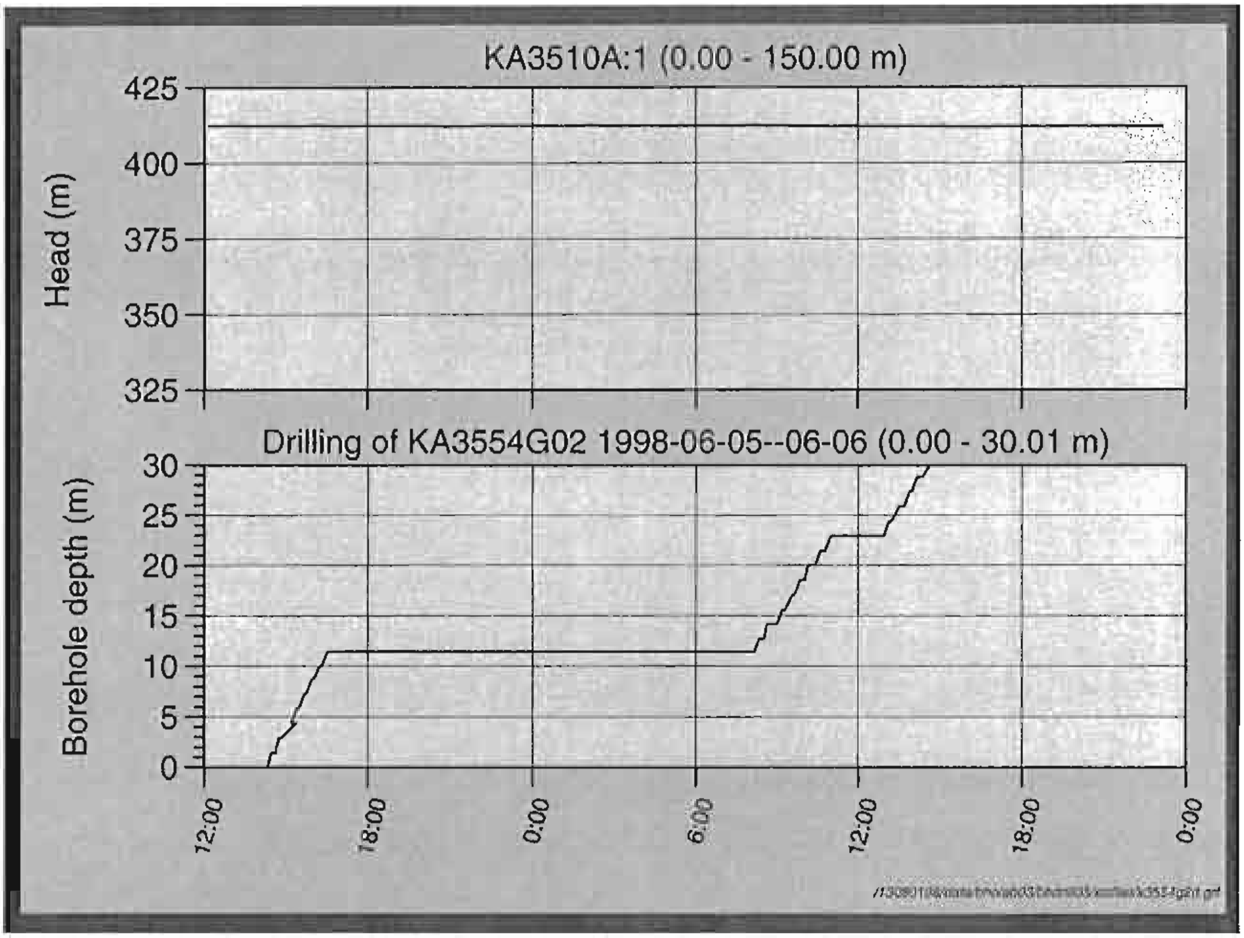

KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3554G01 1998-06-07 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00

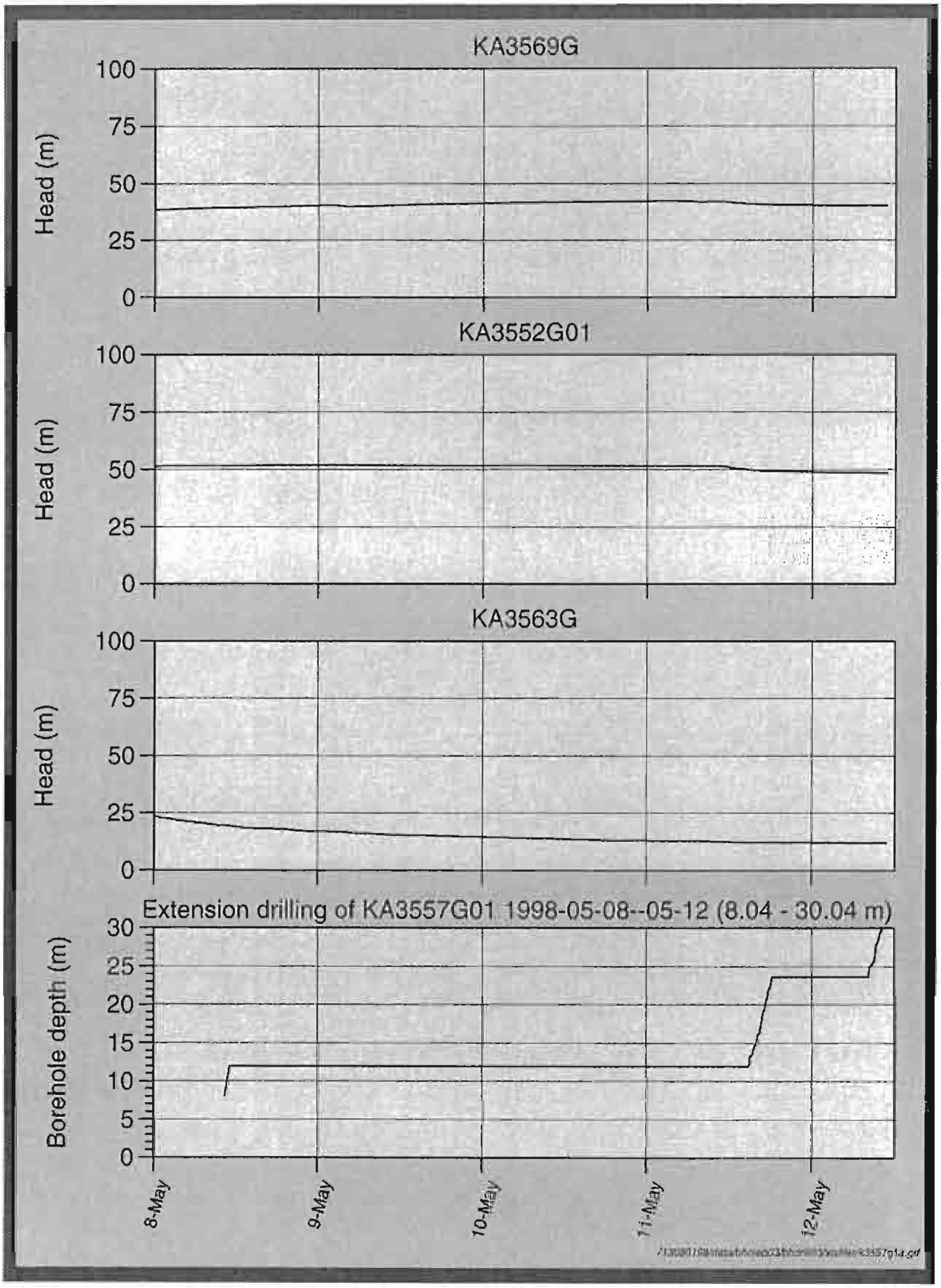

KA3548G01
KA3550G01
KA3551G
KA3552G01
Drilling of KA3554G02 1998-06-05--06-06 (0.00 - 30.01 m)
Head (m)
Borehole depth (m)
100
75
50
25
0
30
25
20
15
10
5
12:00
18:00
0:00
6:00


KA3557G
Head (m)
100
75
50
25
0
KA3563G
Head (m)
100
75
50
25
0
KA3546G01
Head (m)
100
75
50
25
0
Drilling of KA3554G02 1998-06-05--06-06 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

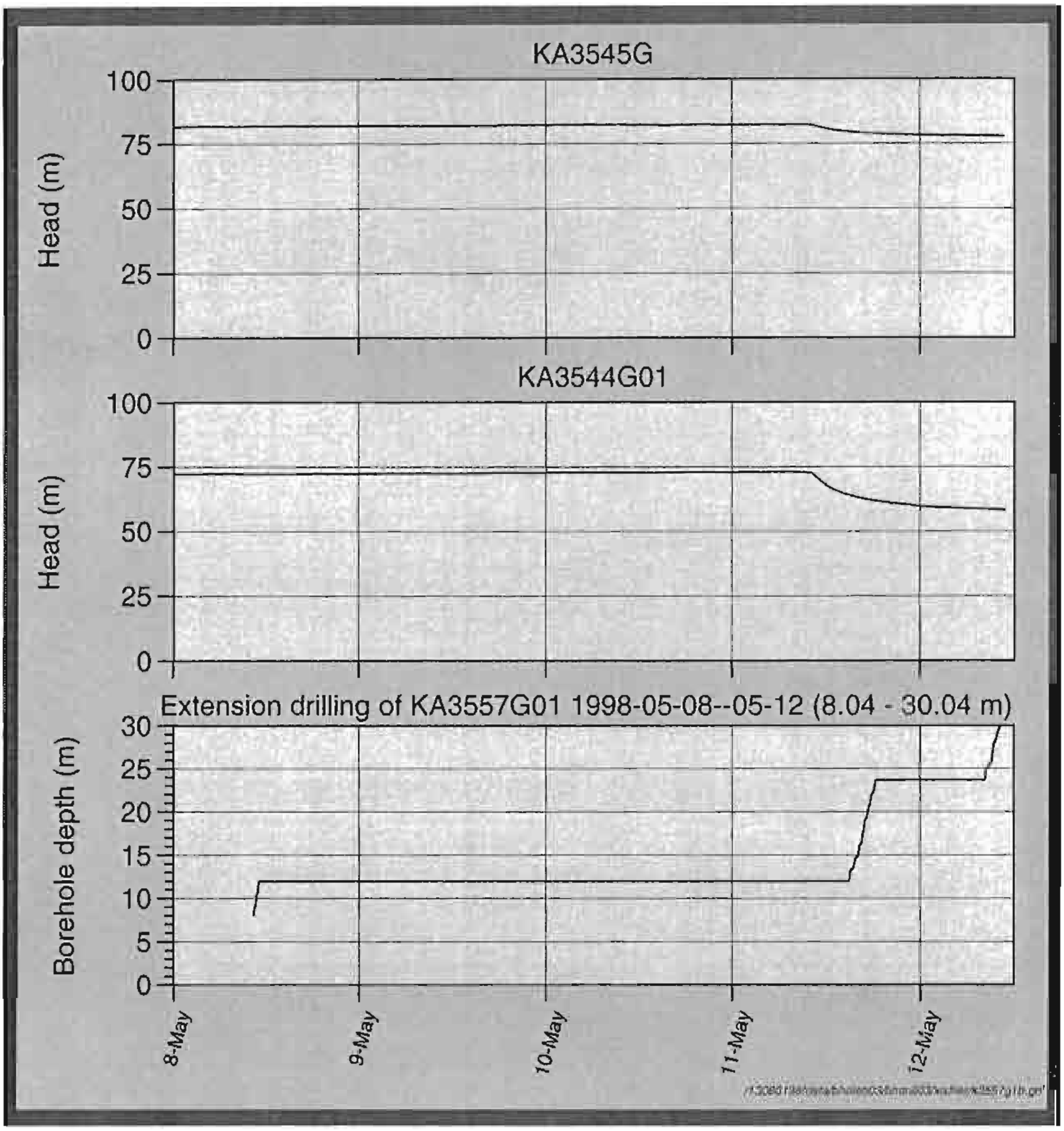


KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Drilling of KA3554G02 1998-06-05--06-06 (0.00 - 30.01 m)
Head (m)
Borehole depth (m)
425
400
375
350
325
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

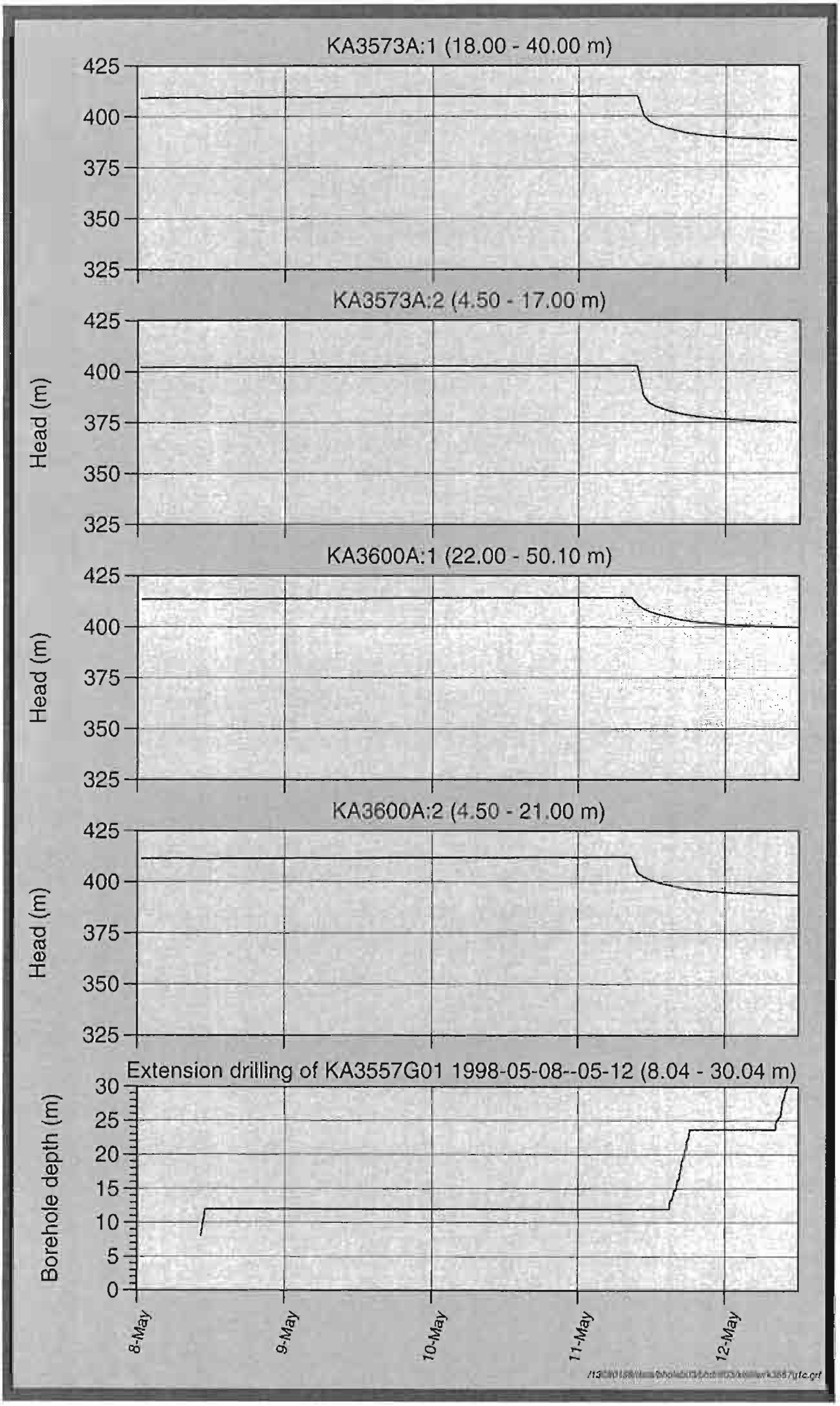

KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3554G02 1998-06-05--06-06 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

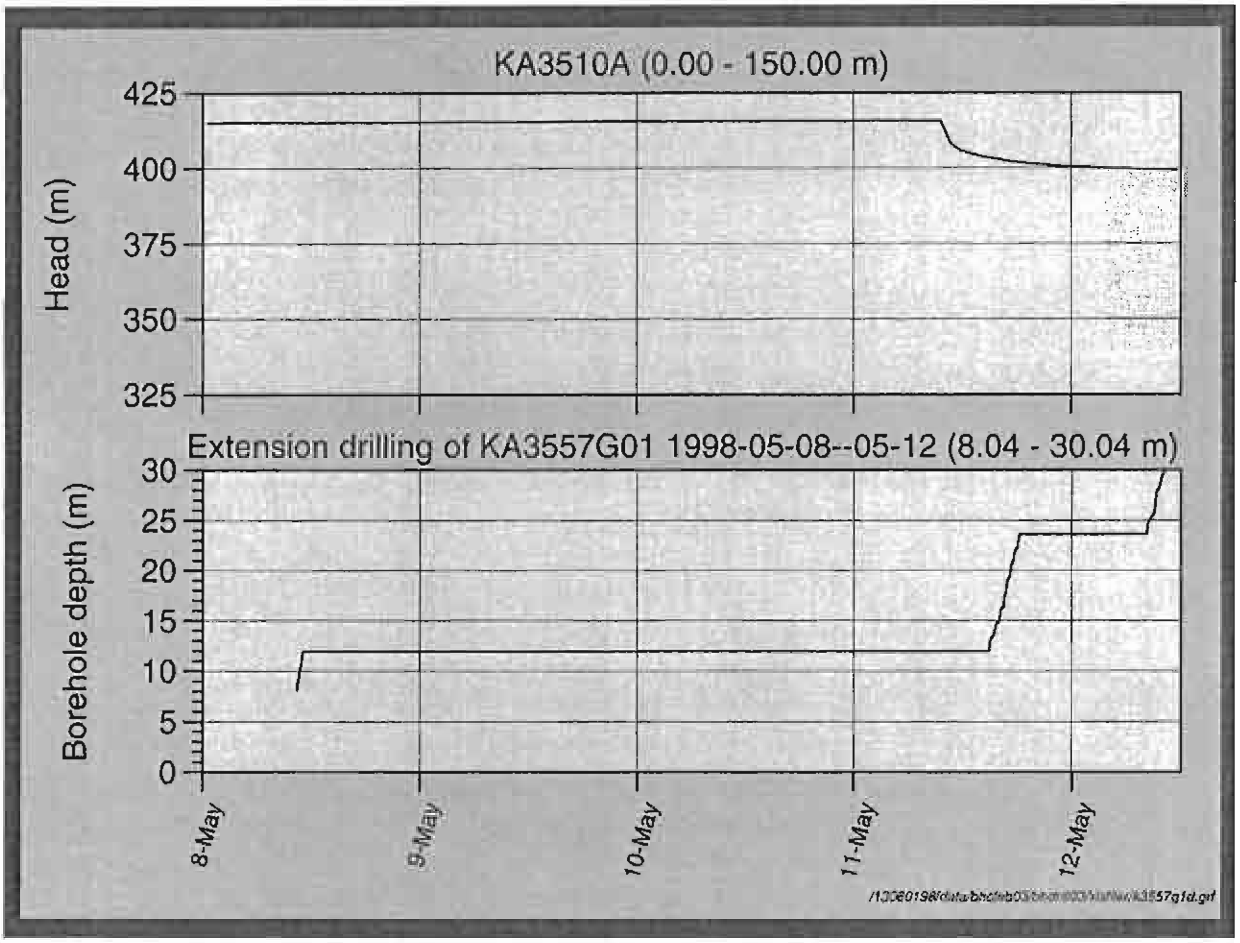


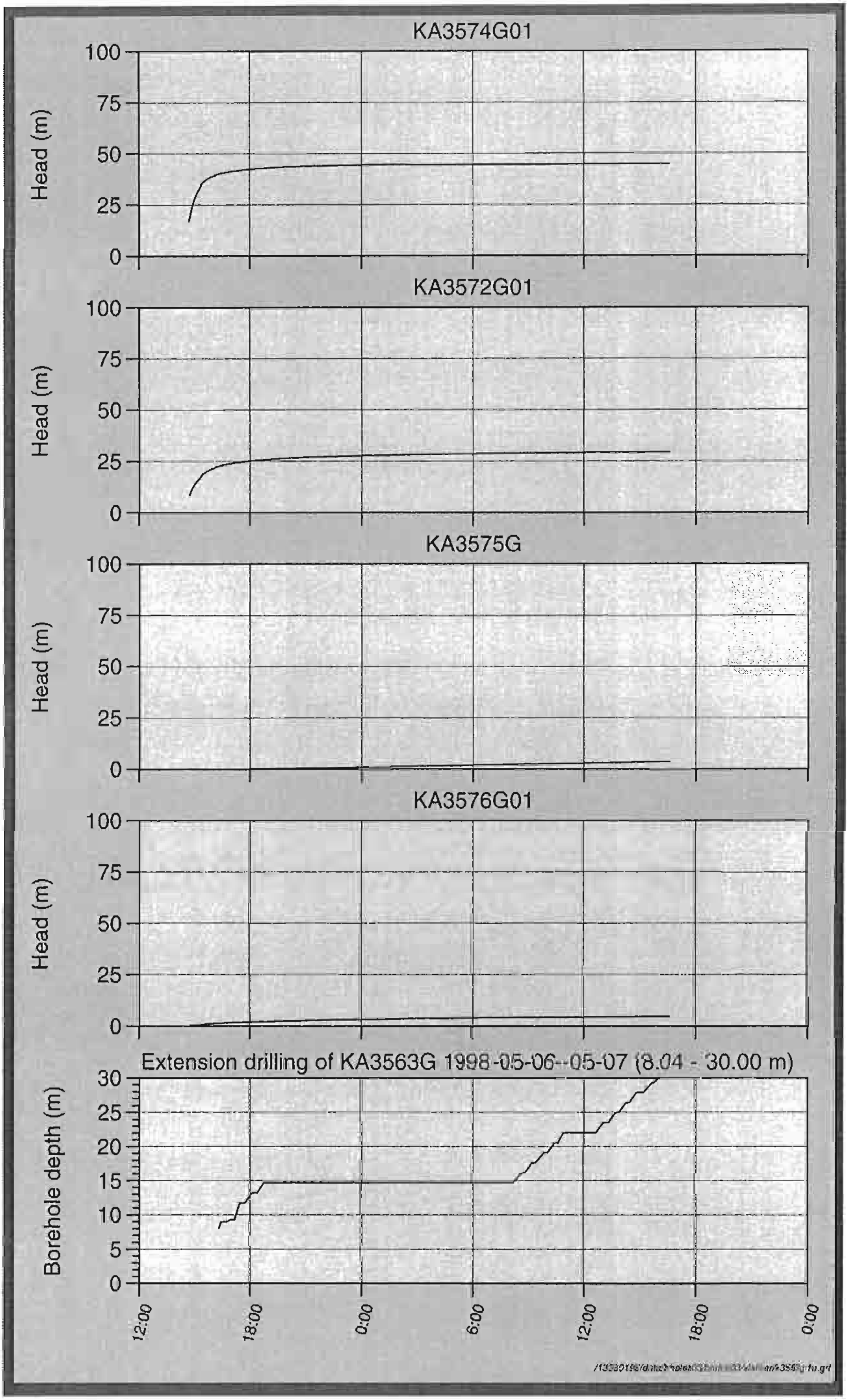
KA3569G
Head (m)
KA3552G01
Head (m)
KA3563G
Head (m)
Extension drilling of KA3557G01 1998-05-08--05-12 (8.04 - 30.04 m)
Borehole depth (m)
8-May
9-May
10-May
11-May
12-May

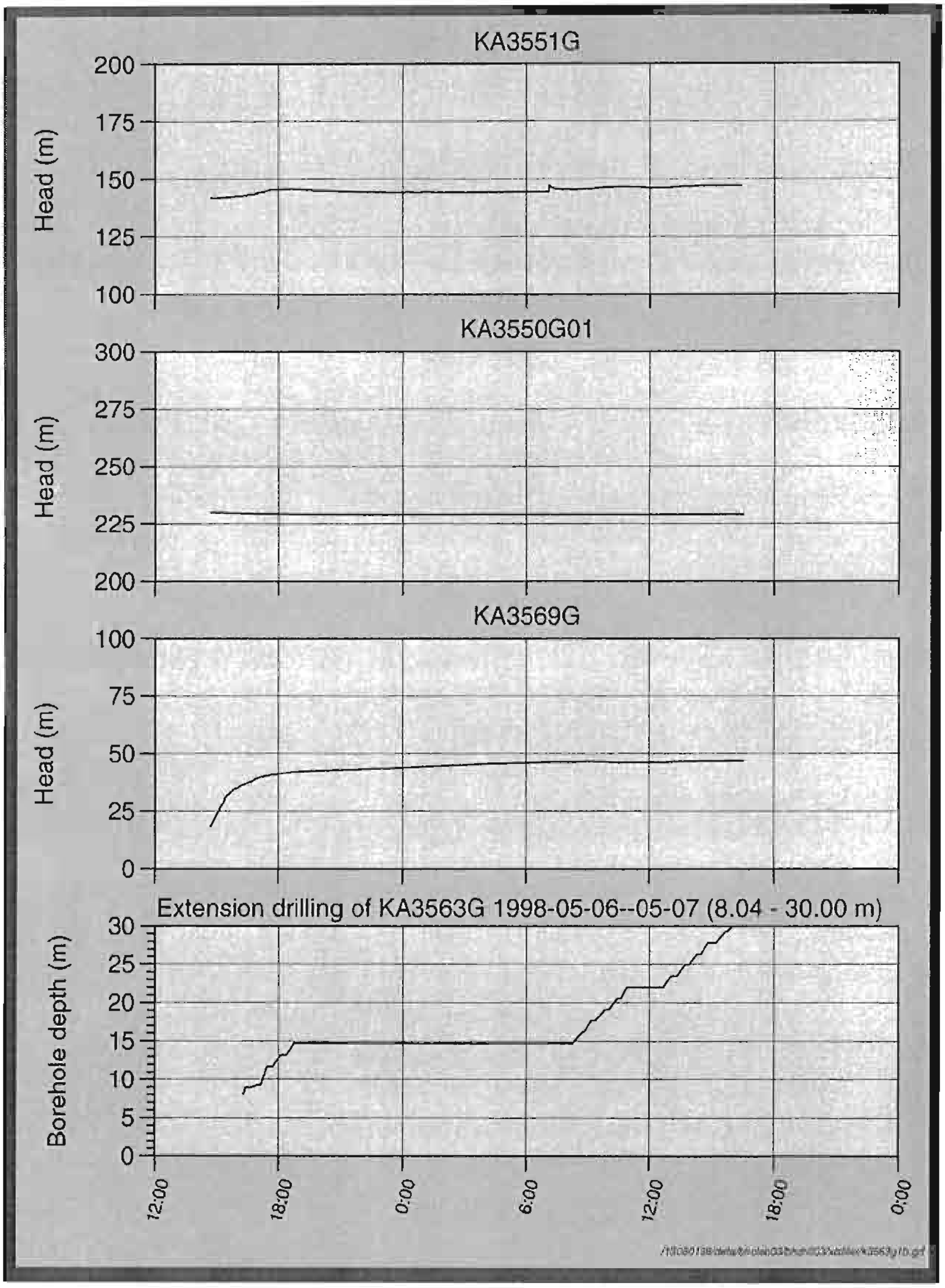


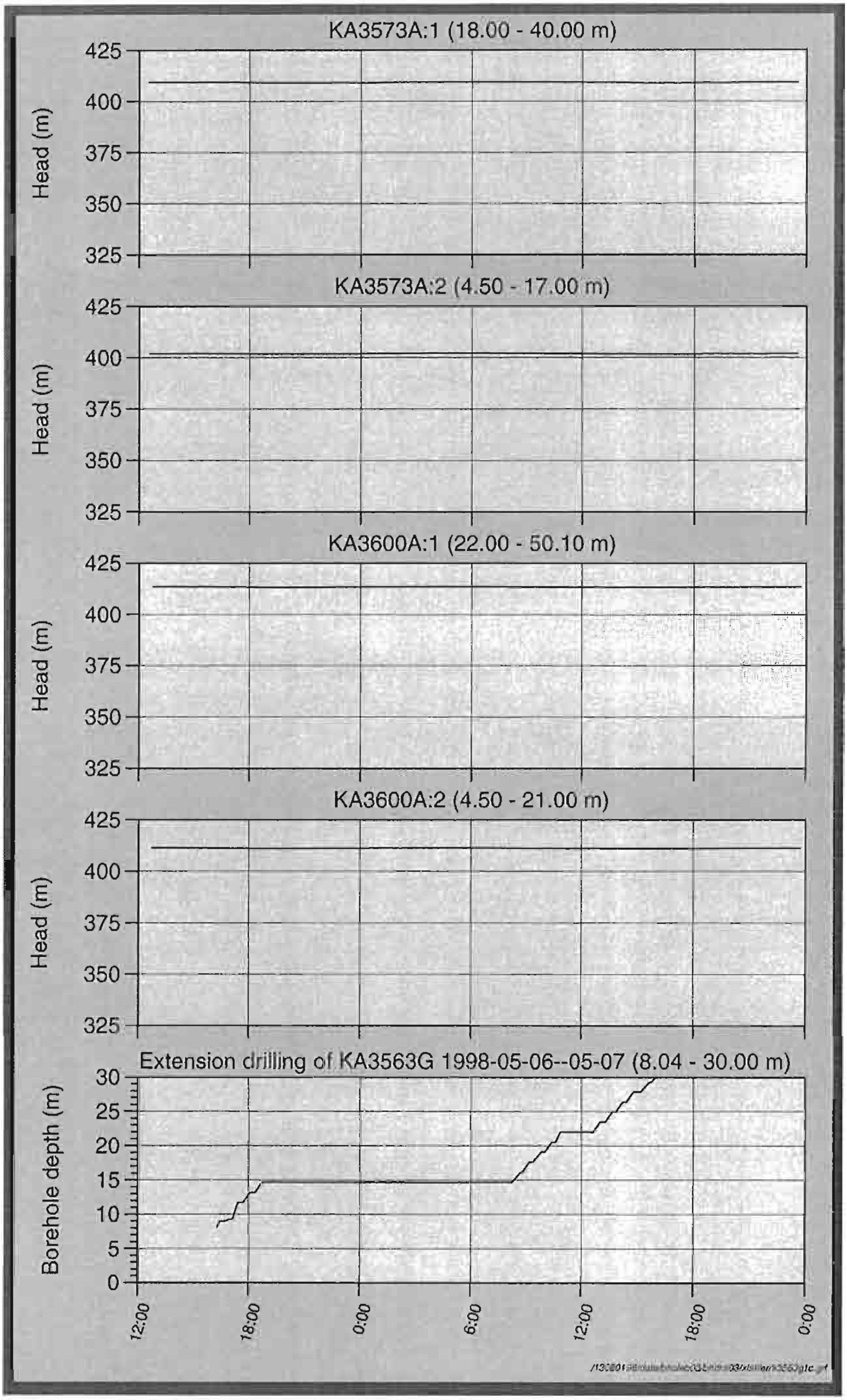
KA3545G
Head (m)
100
75
50
25
0
KA3544G01
Head (m)
100
75
50
25
0
Extension drilling of KA3557G01 1998-05-08--05-12 (8.04 - 30.04 m)
Borehole depth (m)
30
25
20
15
10
5
0
8-May
9-May
10-May
11-May
12-May

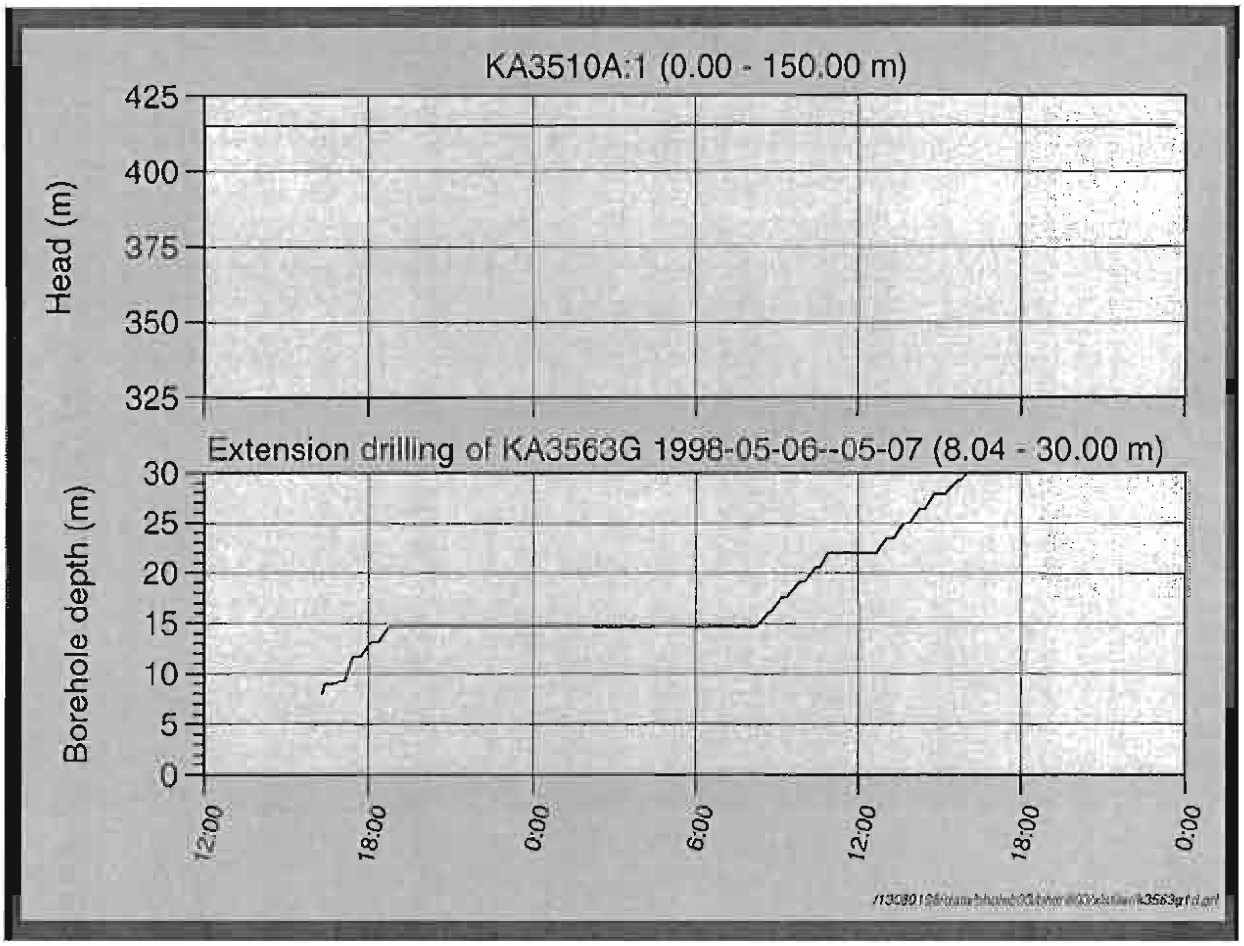

KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Extension drilling of KA3557G01 1998-05-08--05-12 (8.04 - 30.04 m)
Head (m)
Head (m)
Head (m)
Borehole depth (m)
425
400
375
350
325
30
25
20
15
10
5
0
8-May
9-May
10-May
11-May
12-May


KA3510A (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Extension drilling of KA3557G01 1998-05-08--05-12 (8.04 - 30.04 m)
Borehole depth (m)
30
25
20
15
10
5
0
8-May
9-May
10-May
11-May
12-May

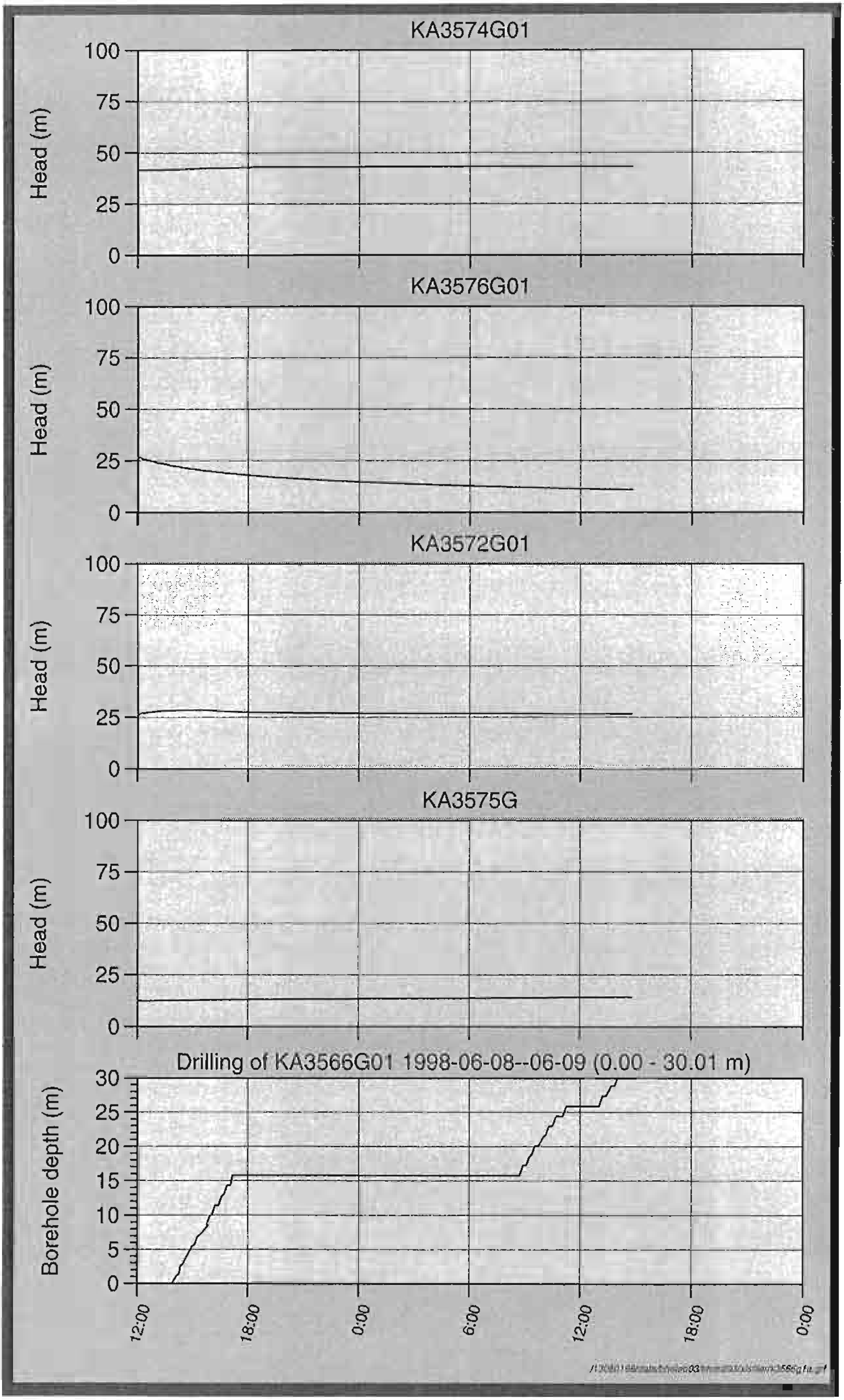

KA3574G01
Head (m)
100
75
50
25
0
KA3572G01
Head (m)
100
75
50
25
0
KA3575G
Head (m)
100
75
50
25
0
KA3576G01
Head (m)
100
75
50
25
0
Extension drilling of KA3563G 1998-05-06--05-07 (8.04 - 30.00 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00


KA3551G
Head (m)
200
175
150
125
100
KA3550G01
Head (m)
300
275
250
225
200
KA3569G
Head (m)
100
75
50
25
0
Extension drilling of KA3563G 1998-05-06--05-07 (8.04 - 30.00 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

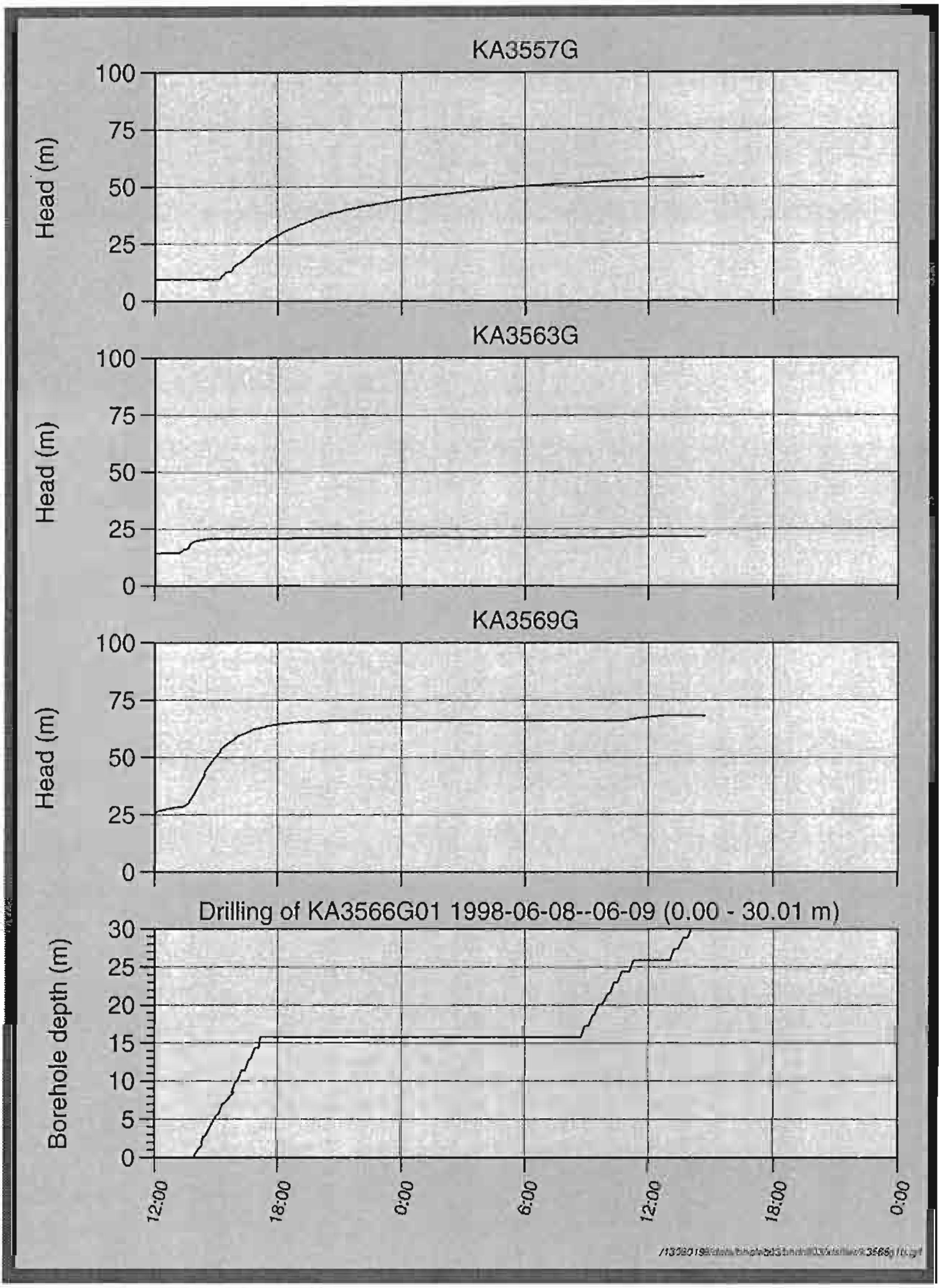

KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Extension drilling of KA3563G 1998-05-06--05-07 (8.04 - 30.00 m)
Head (m)
Borehole depth (m)
425
400
375
350
325
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

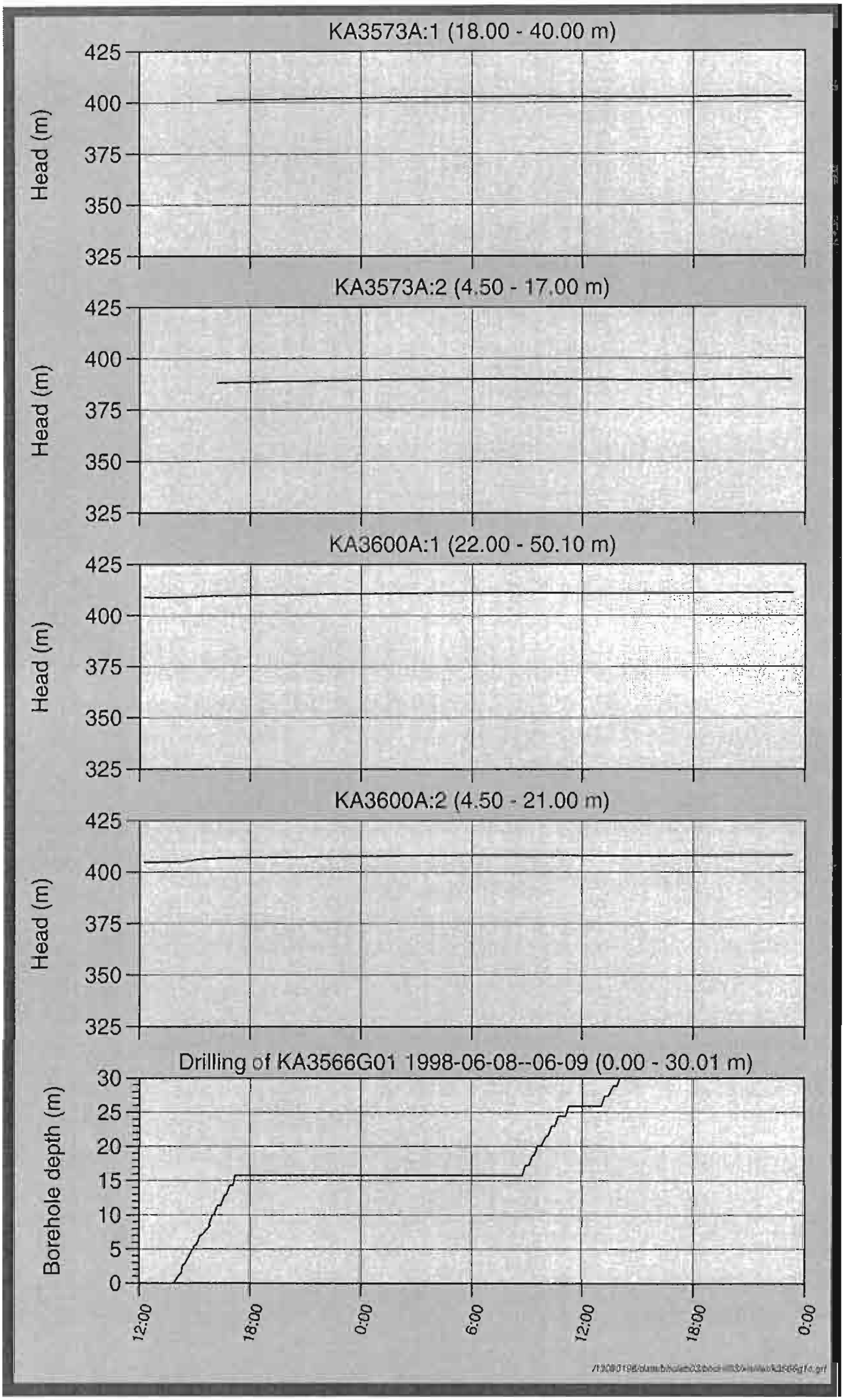


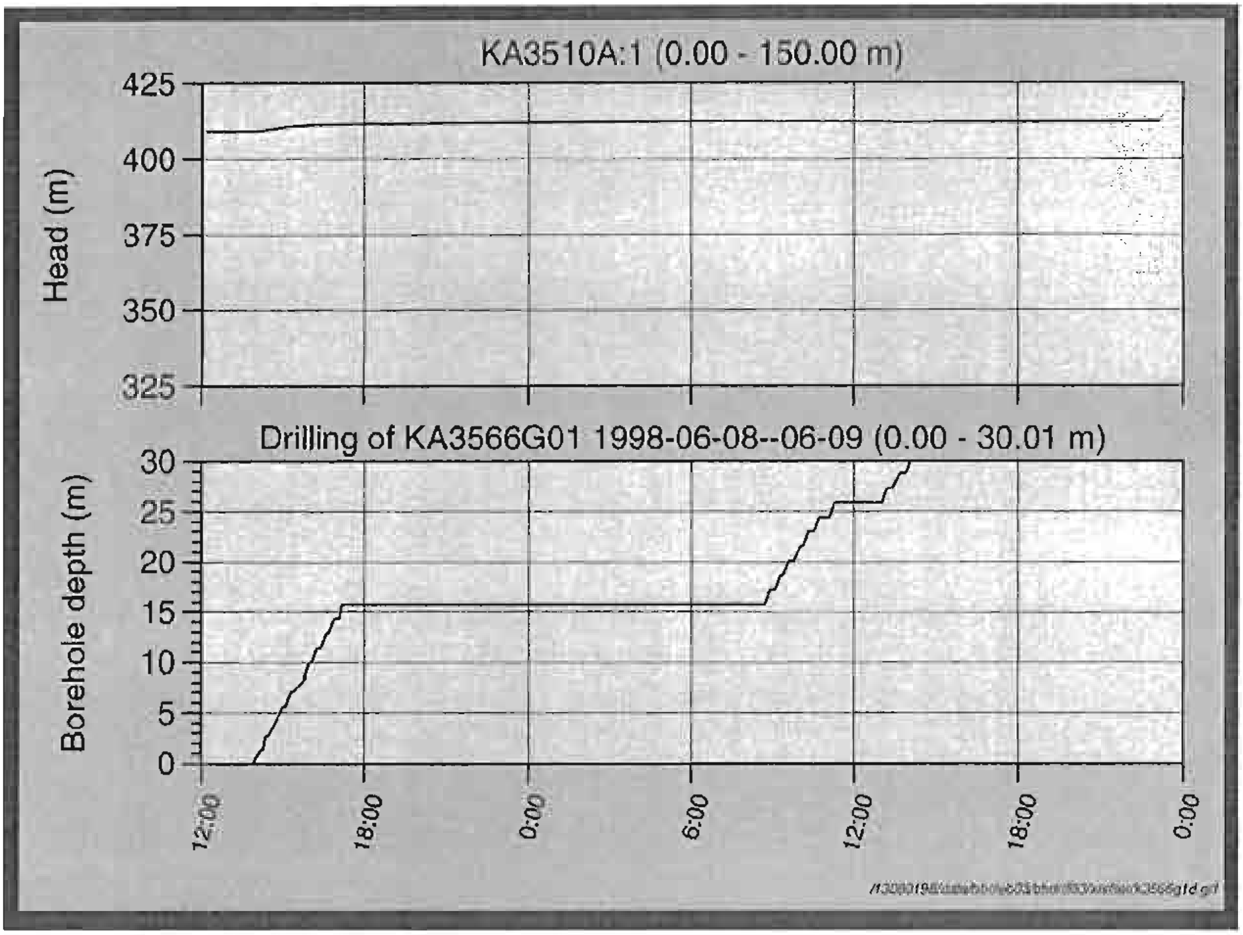
KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Extension drilling of KA3563G 1998-05-06--05-07 (8.04 - 30.00 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

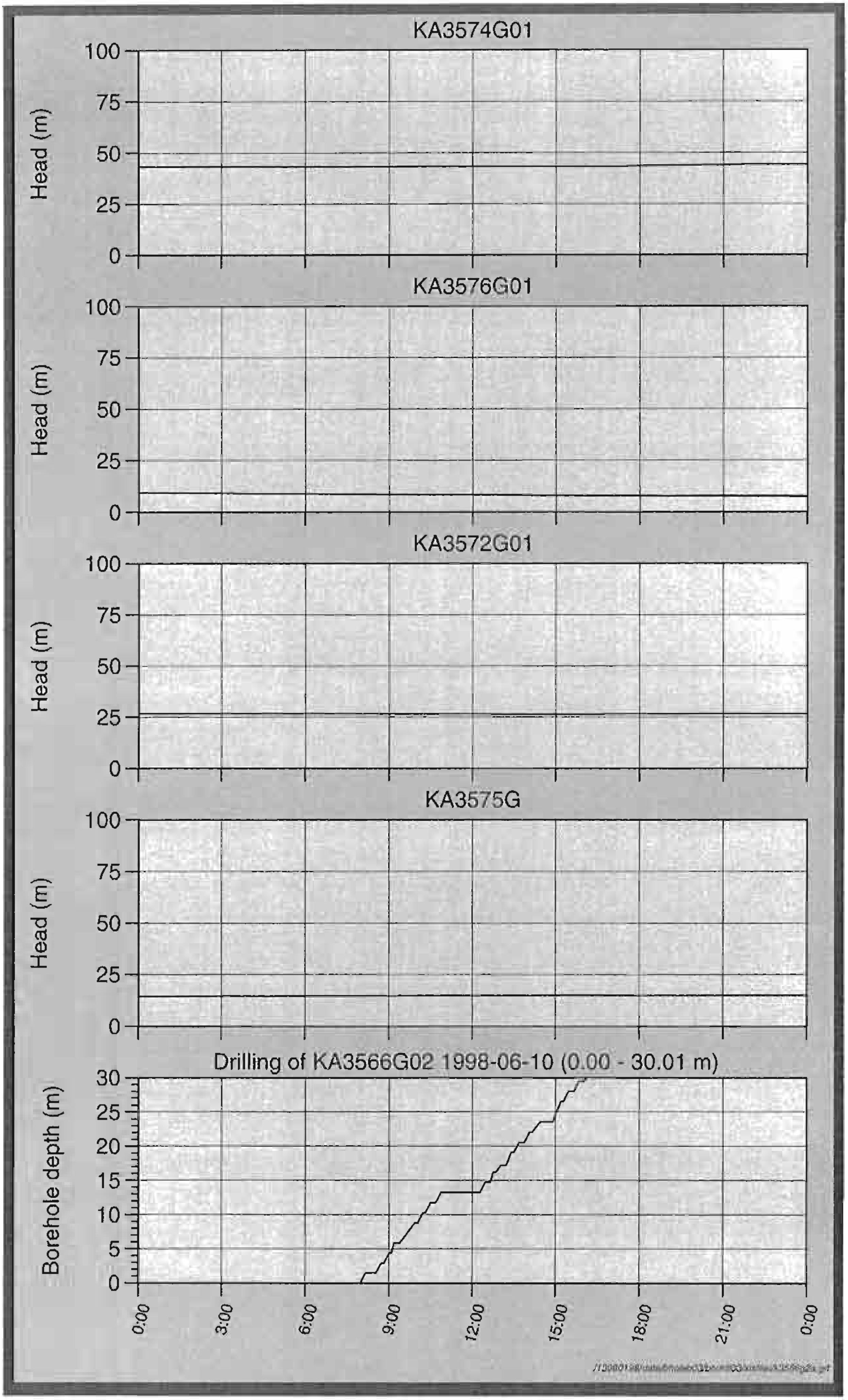


KA3574G01
KA3576G01
KA3572G01
KA3575G
Drilling of KA3566G01 1998-06-08--06-09 (0.00 - 30.01 m)
Head (m)
Borehole depth (m)
100
75
50
25
0
30
25
20
15
10
5
12:00
18:00
0:00
6:00

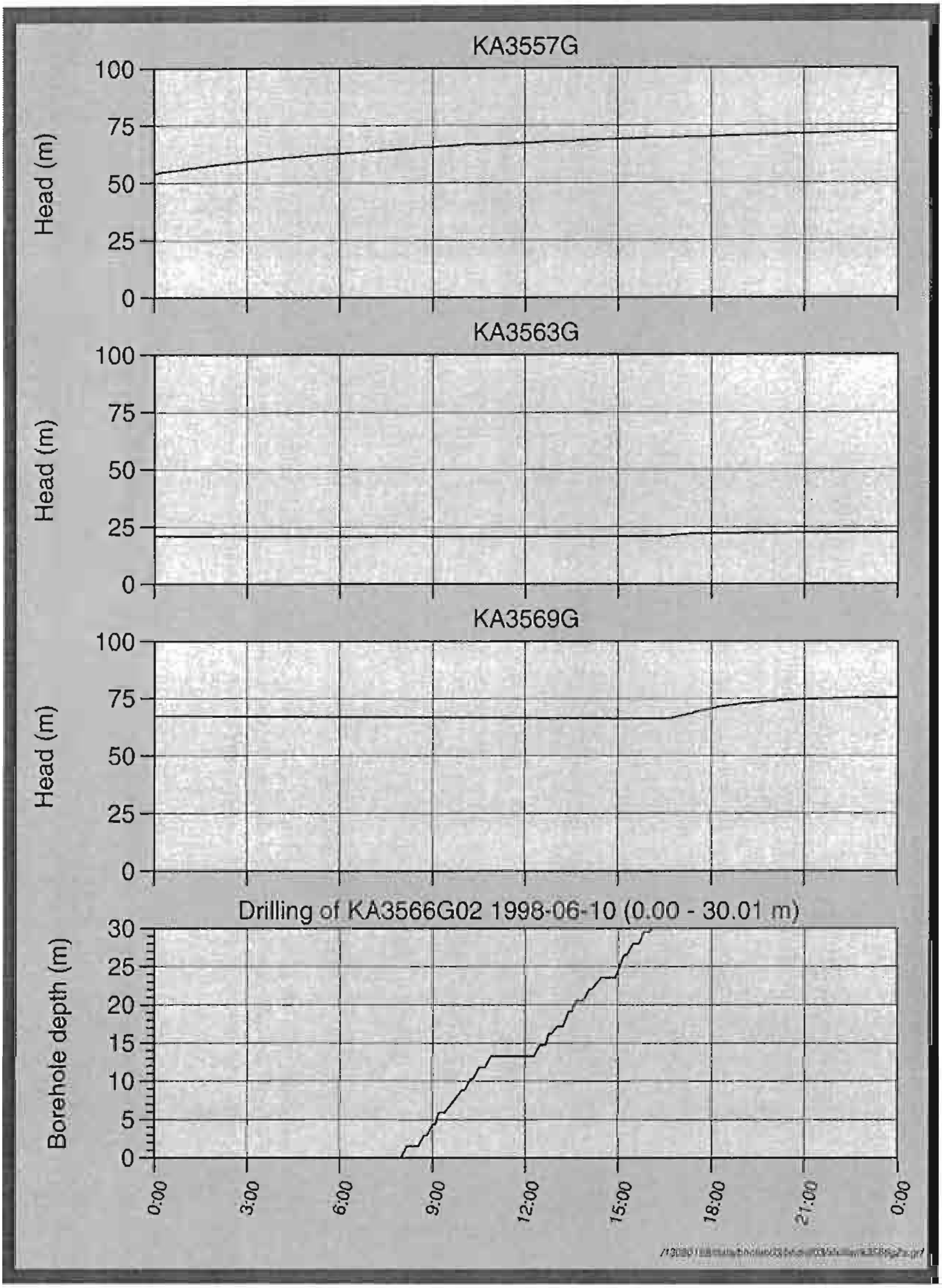

KA3557G
Head (m)
100
75
50
25
0
KA3563G
Head (m)
100
75
50
25
0
KA3569G
Head (m)
100
75
50
25
0
Drilling of KA3566G01 1998-06-08--06-09 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00


KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Drilling of KA3566G01 1998-06-08--06-09 (0.00 - 30.01 m)
Head (m)
Borehole depth (m)
425
400
375
350
325
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

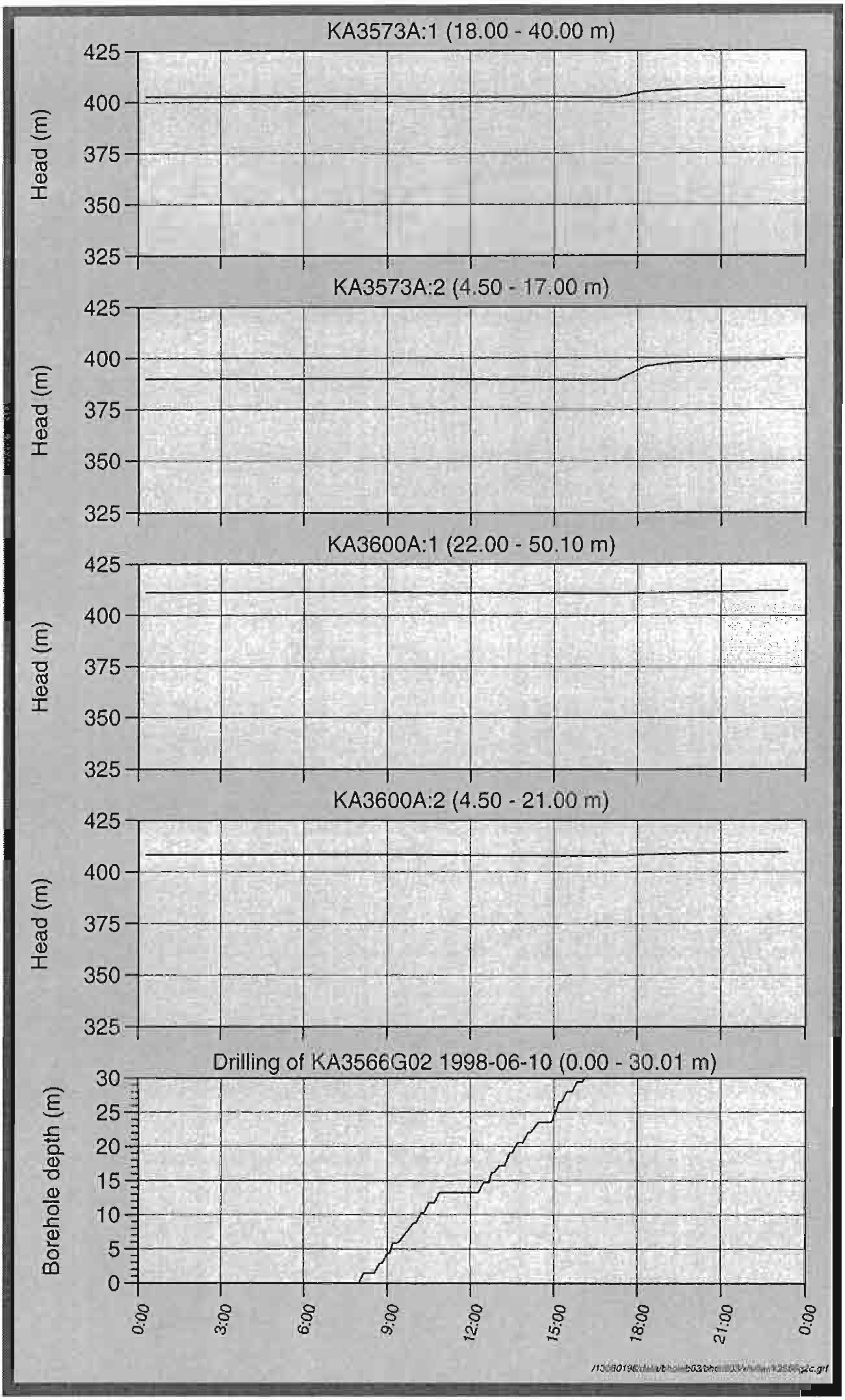

KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3566G01 1998-06-08--06-09 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

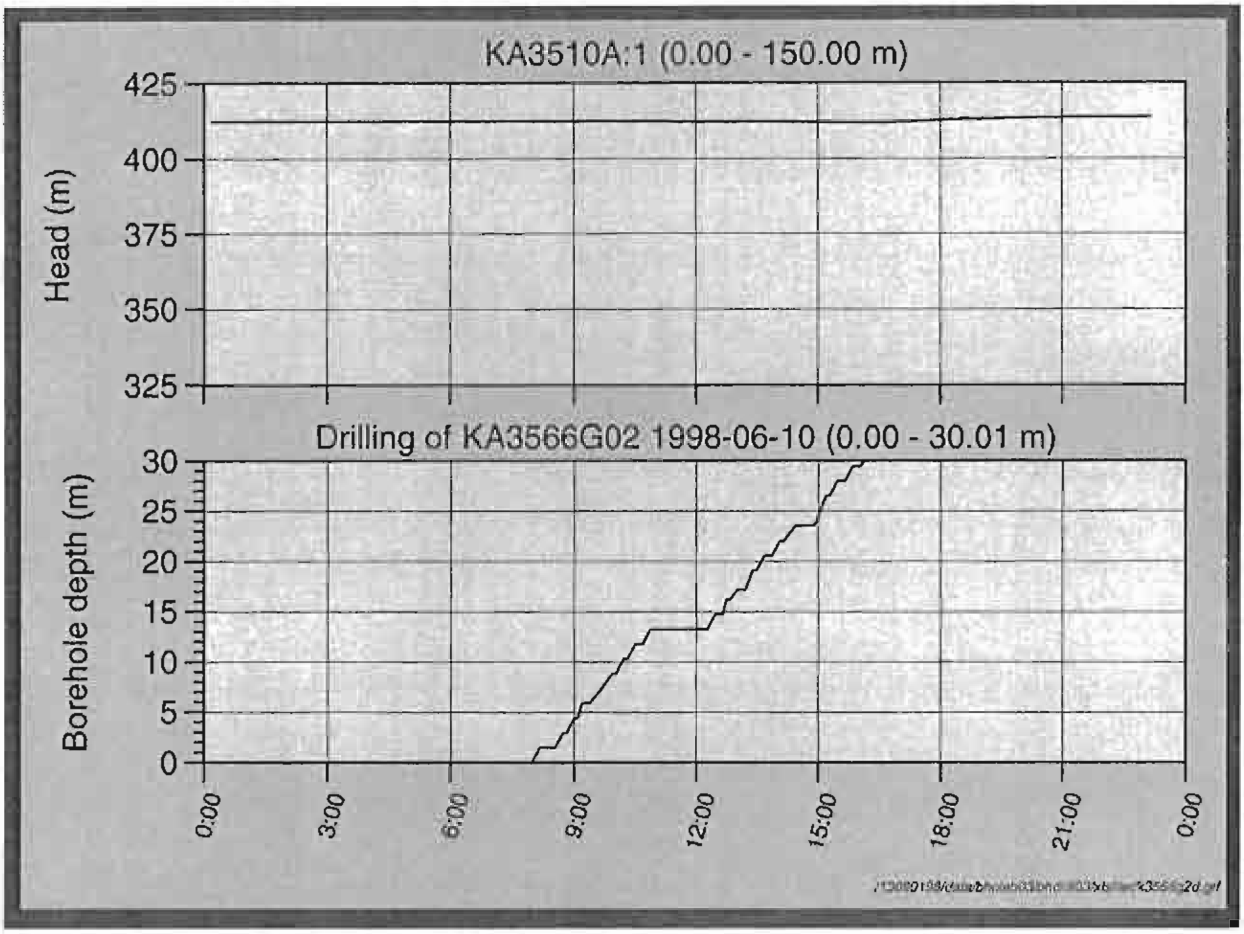


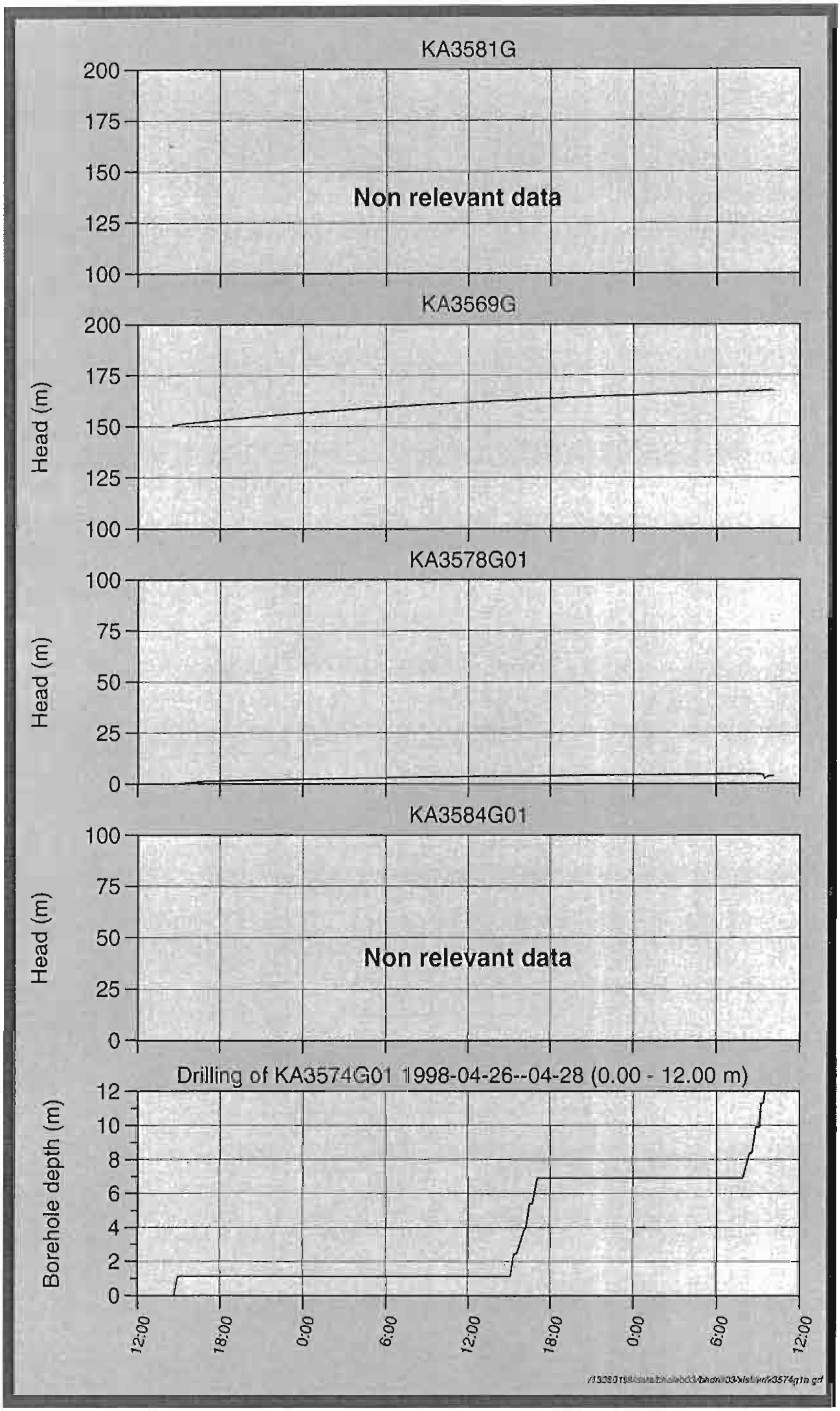
KA3574G01
KA3576G01
KA3572G01
KA3575G
Head (m)
100
75
50
25
0
Drilling of KA3566G02 1998-06-10 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00



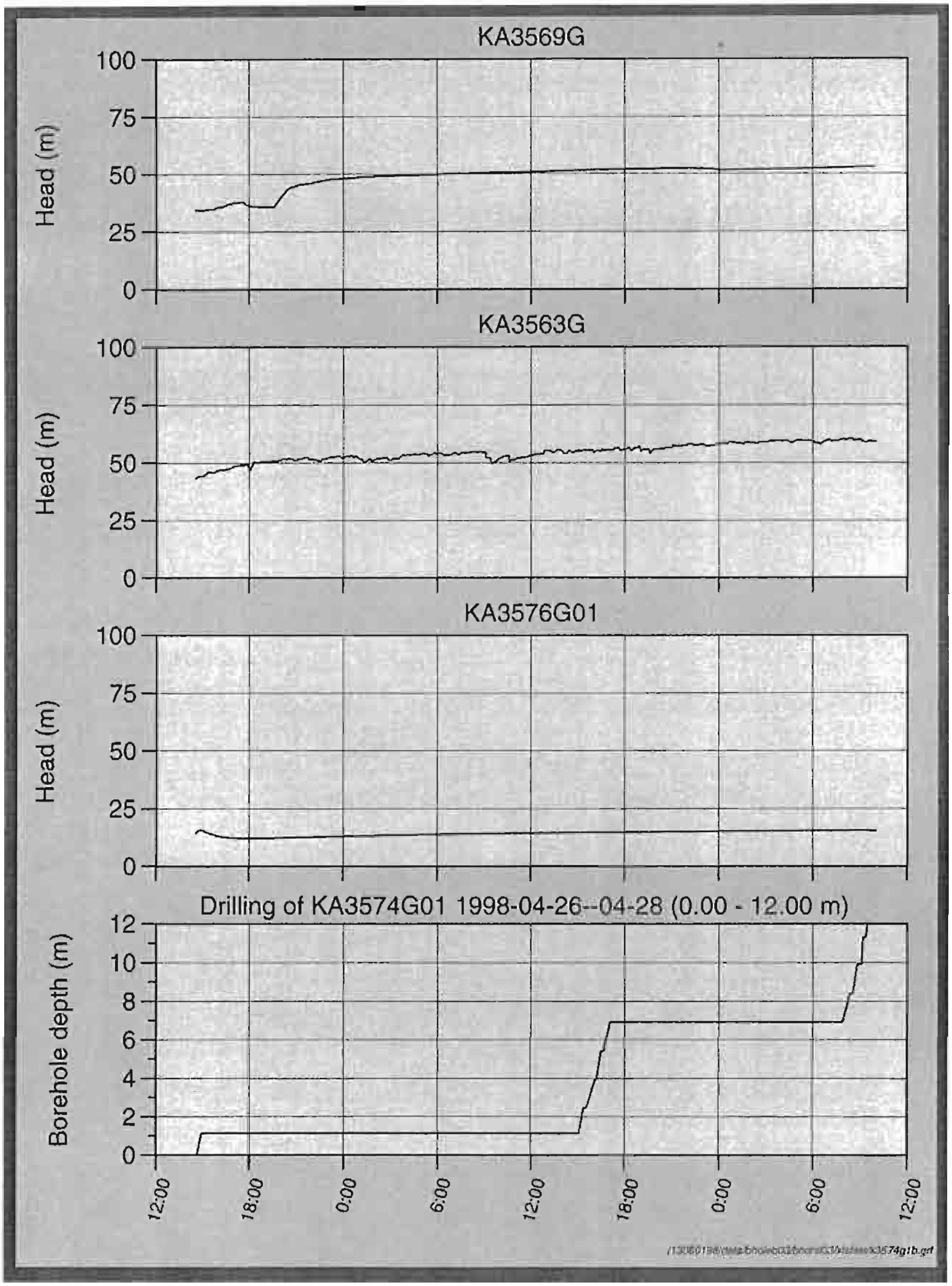
KA3557G
Head (m)
KA3563G
Head (m)
KA3569G
Head (m)
Drilling of KA3566G02 1998-06-10 (0.00 - 30.01 m)
Borehole depth (m)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00

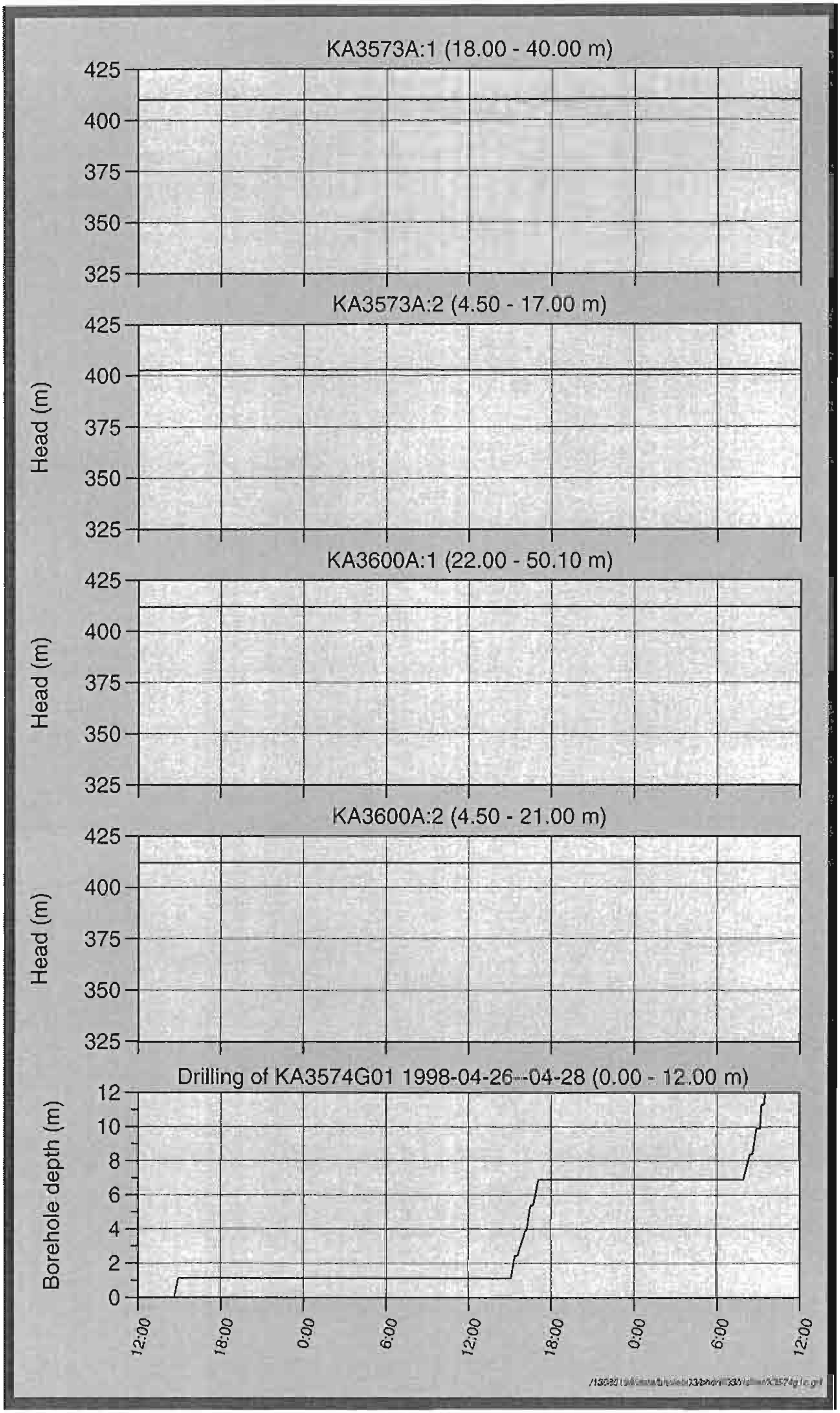

KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Drilling of KA3566G02 1998-06-10 (0.00 - 30.01 m)
Head (m)
Borehole depth (m)
425
400
375
350
325
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00


KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3566G02 1998-06-10 (0.00 - 30.01 m)
Borehole depth (m)
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00

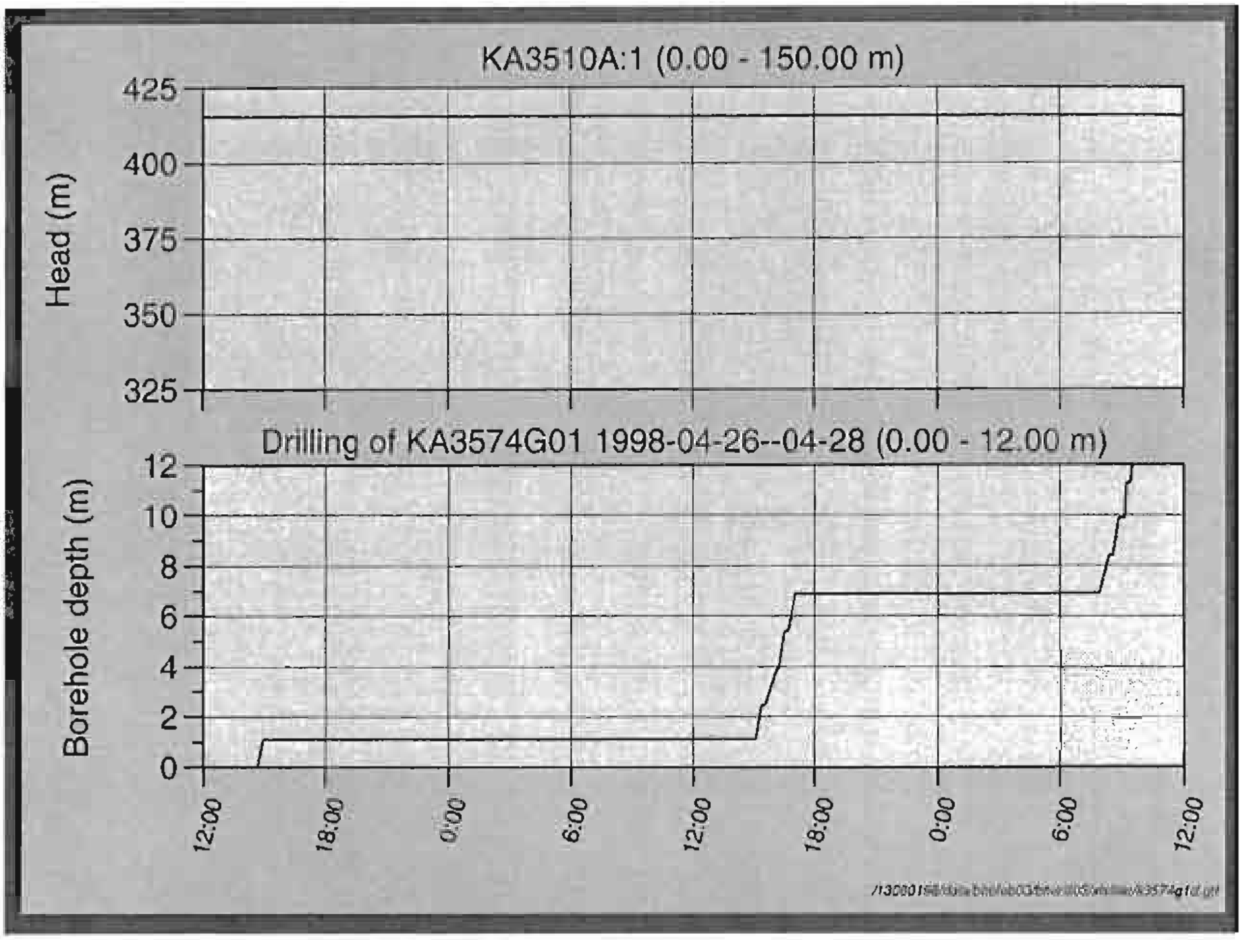


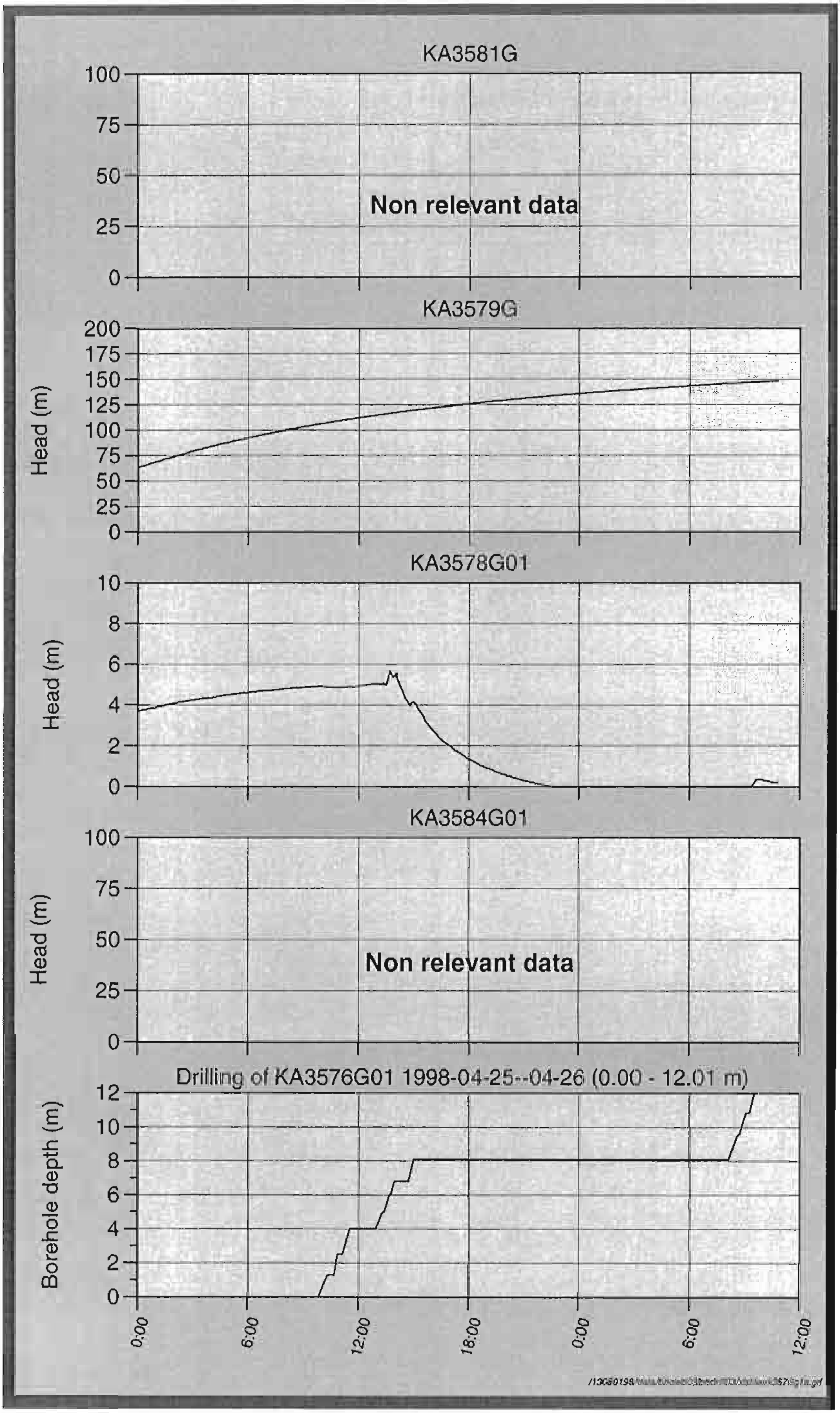
KA3581G
200
175
150
125
100
Non relevant data
KA3569G
200
175
150
125
100
Head (m)
KA3578G01
100
75
50
25
0
Head (m)
KA3584G01
100
75
50
25
0
Head (m)
Non relevant data
Drilling of KA3574G01 1998-04-26--04-28 (0.00 - 12.00 m)
12
10
8
6
4
2
0
Borehole depth (m)
12:00
18:00
0:00
6:00
12:00
18:00
0:00
6:00
12:00

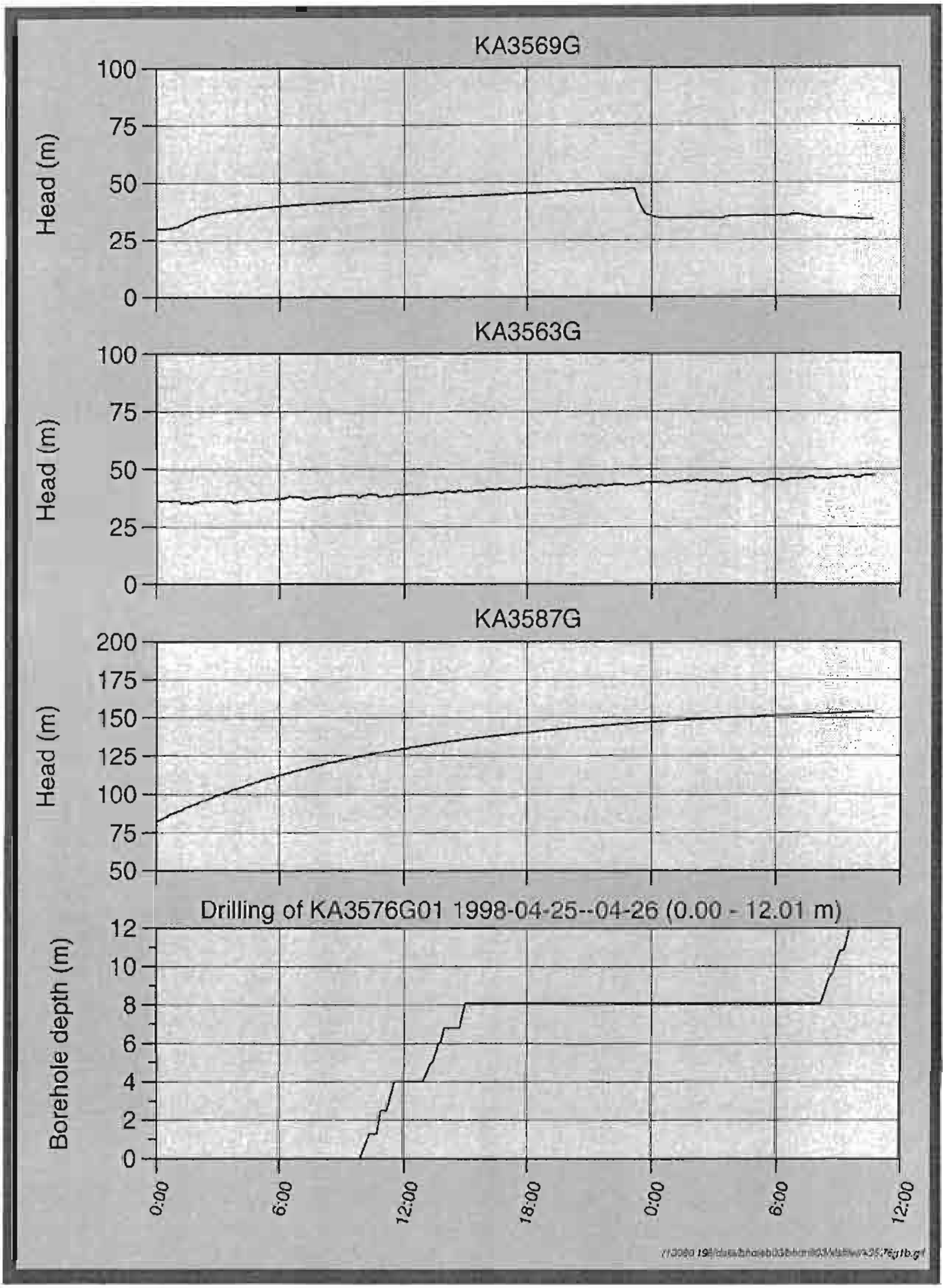

KA3569G
Head (m)
100
75
50
25
0
KA3563G
Head (m)
100
75
50
25
0
KA3576G01
Head (m)
100
75
50
25
0
Drilling of KA3574G01 1998-04-26--04-28 (0.00 - 12.00 m)
Borehole depth (m)
12
10
8
6
4
2
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00
6:00
12:00



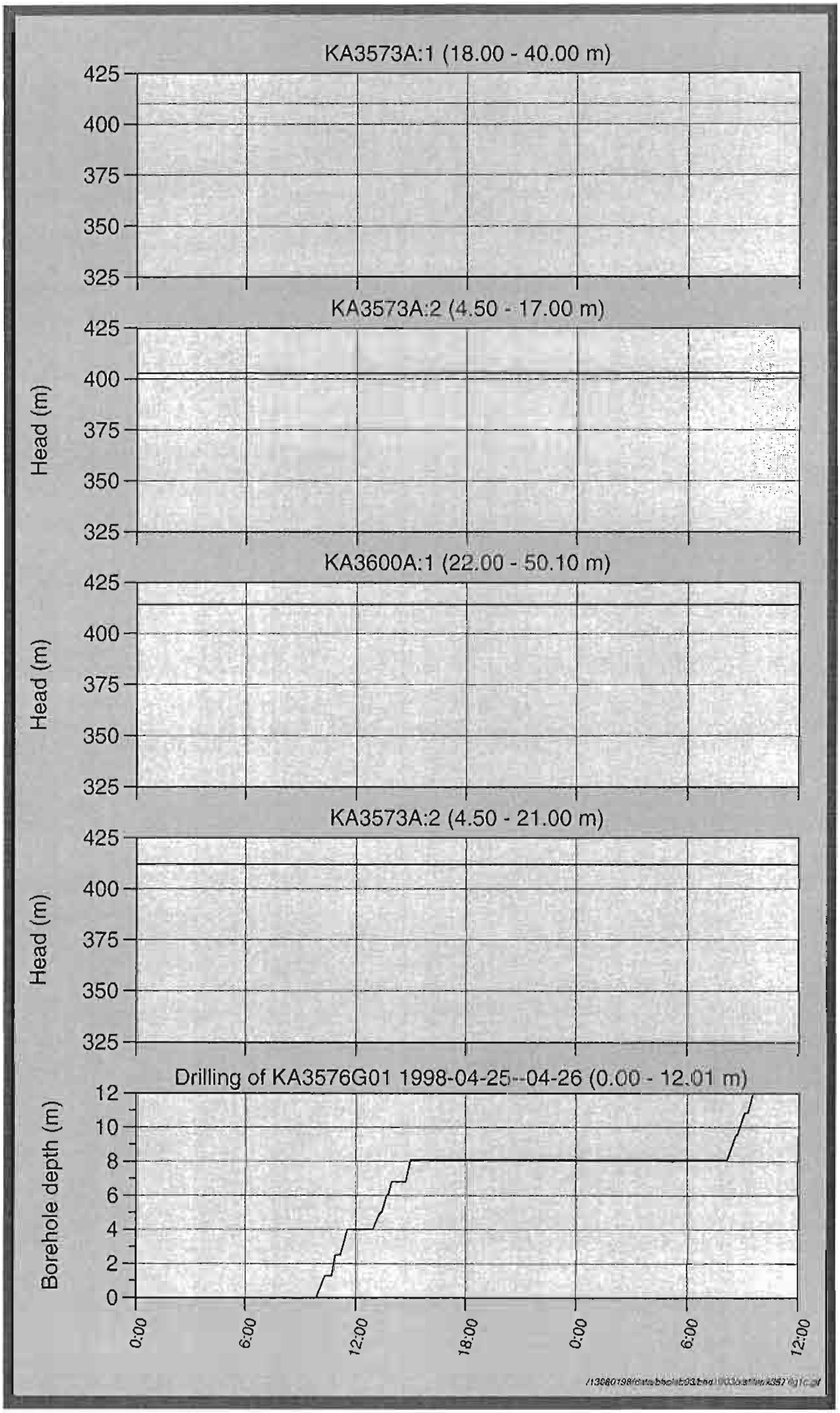
KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Drilling of KA3574G01 1998-04-26--04-28 (0.00 - 12.00 m)
Head (m)
Head (m)
Head (m)
Borehole depth (m)
425
400
375
350
325
12
10
8
6
4
2
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00
6:00
12:00

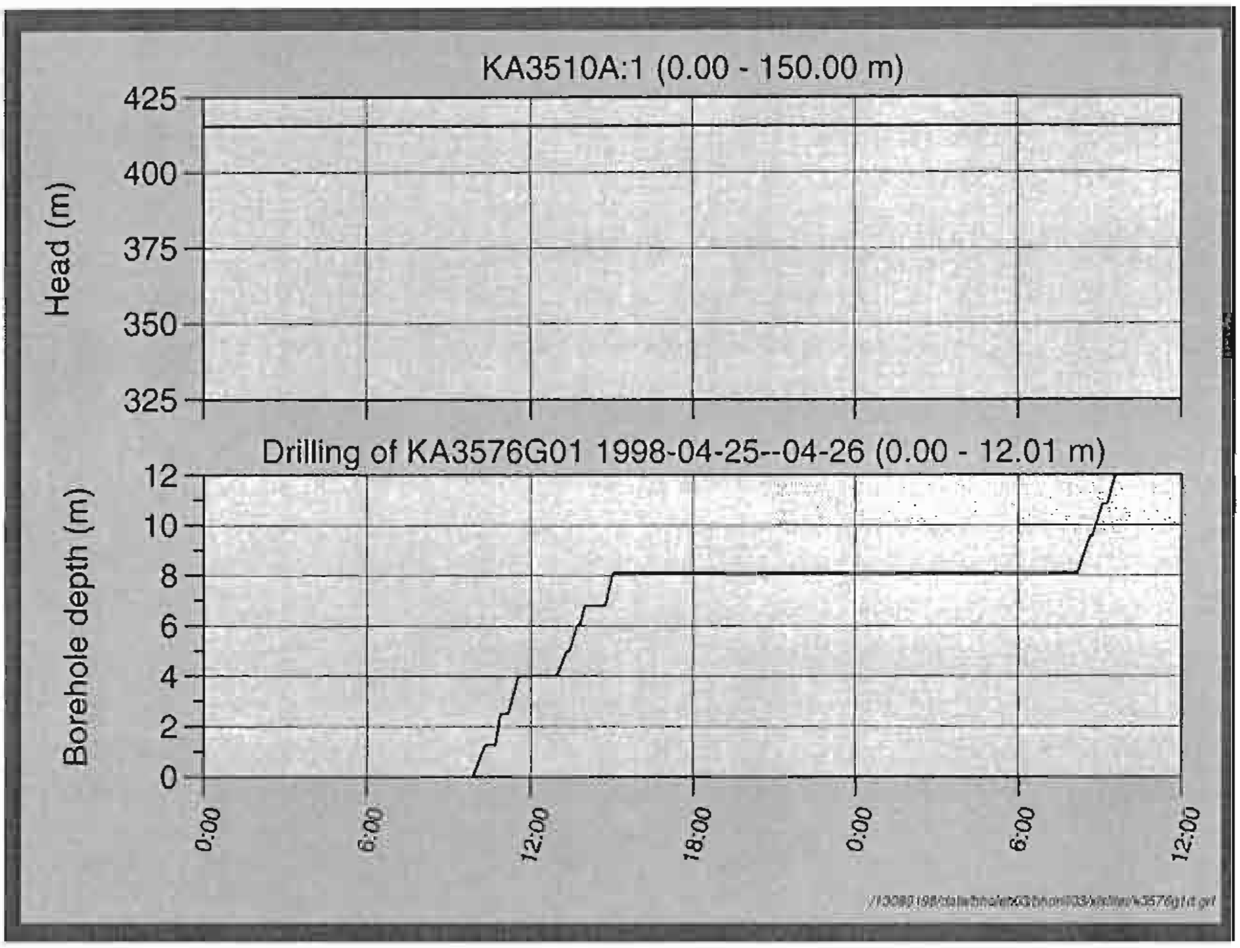

KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3574G01 1998-04-26--04-28 (0.00 - 12.00 m)
Borehole depth (m)
12
10
8
6
4
2
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00
6:00
12:00


KA3581G
Non relevant data
KA3579G
KA3578G01
KA3584G01
Non relevant data
Drilling of KA3576G01 1998-04-25--04-26 (0.00 - 12.01 m)
Head (m)
Borehole depth (m)
0:00
6:00
12:00
18:00
0:00
6:00
12:00

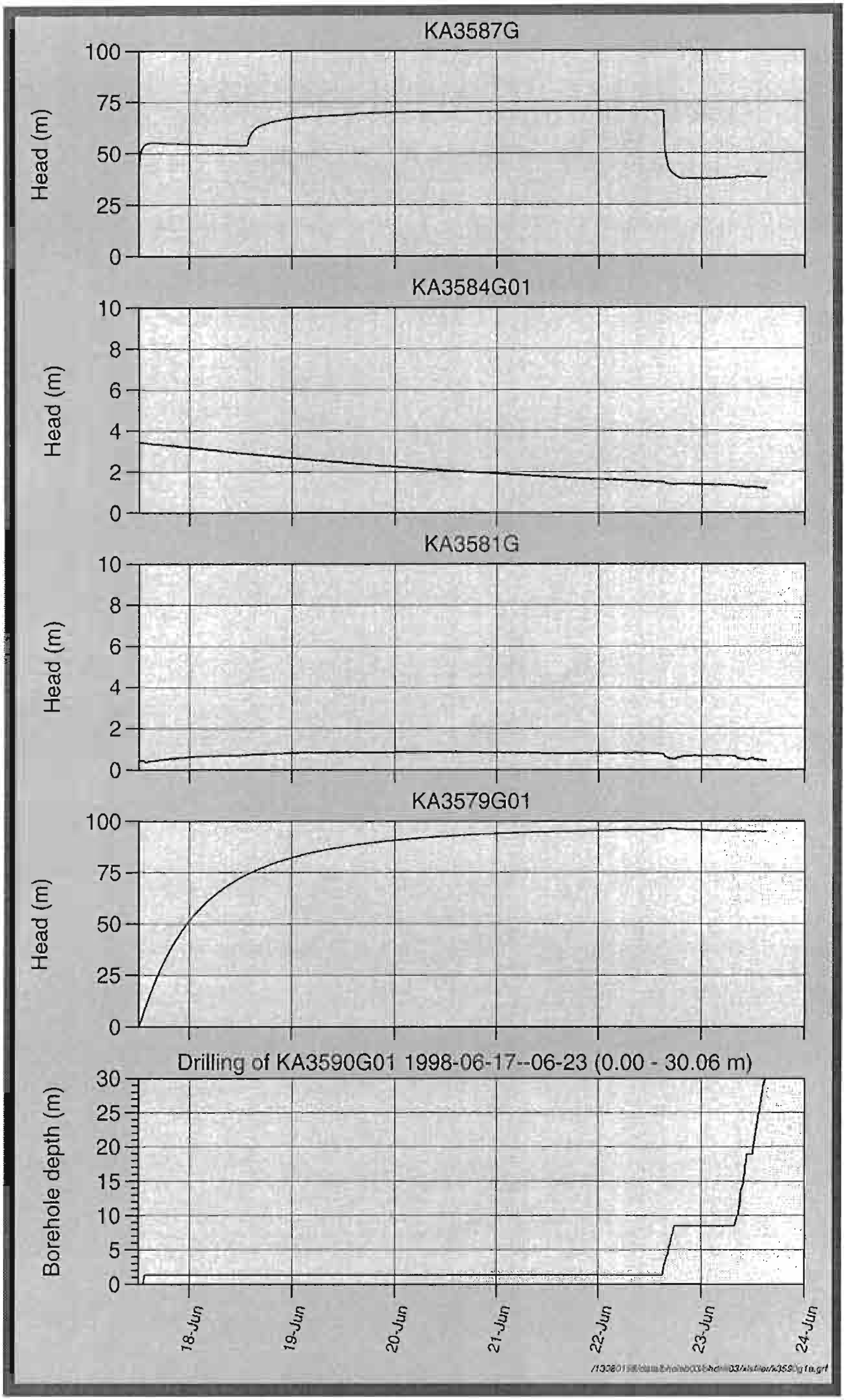


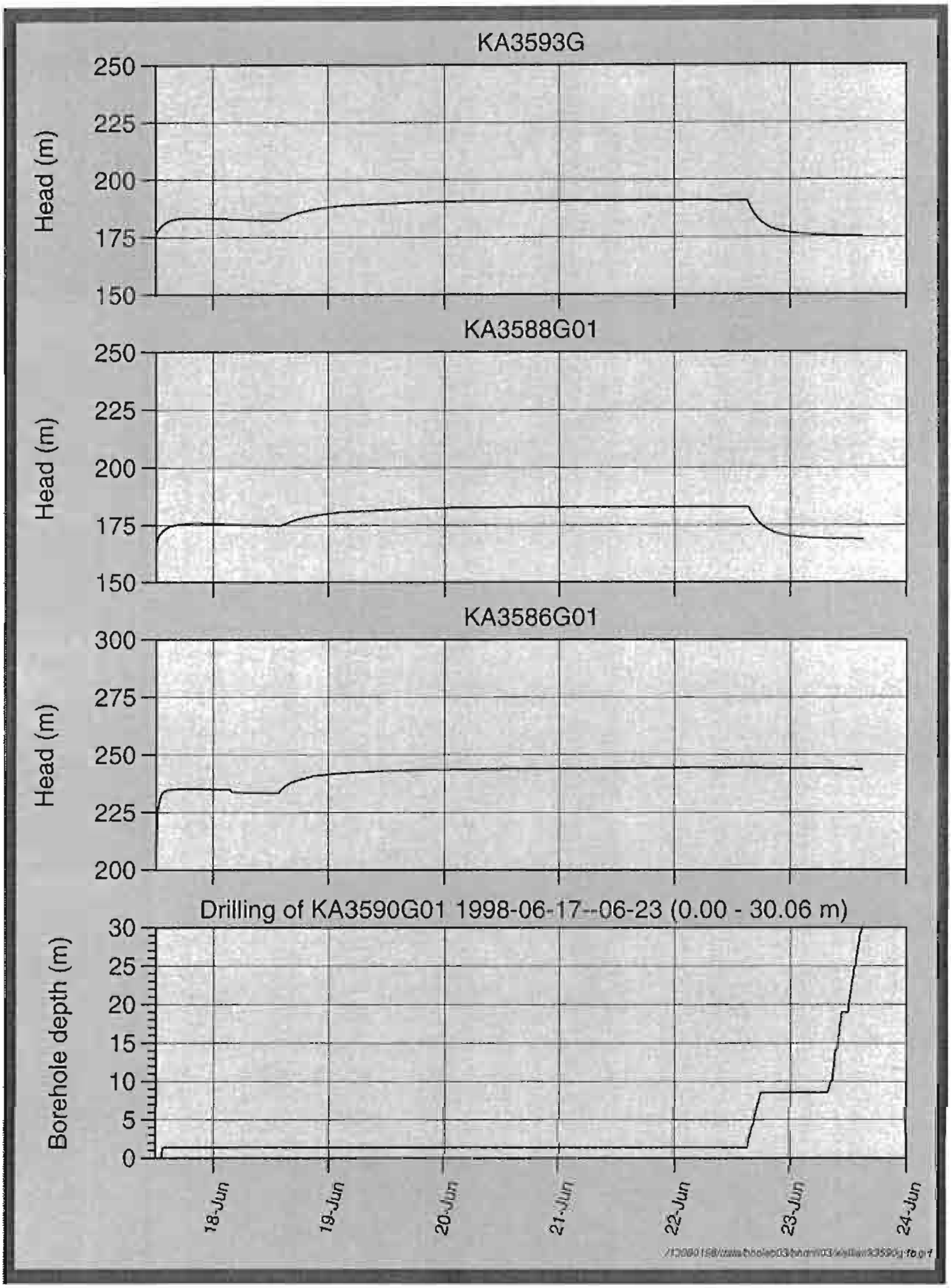
KA3569G
Head (m)
KA3563G
Head (m)
KA3587G
Head (m)
Drilling of KA3576G01 1998-04-25--04-26 (0.00 - 12.01 m)
Borehole depth (m)
0:00
6:00
12:00
18:00
0:00
6:00
12:00

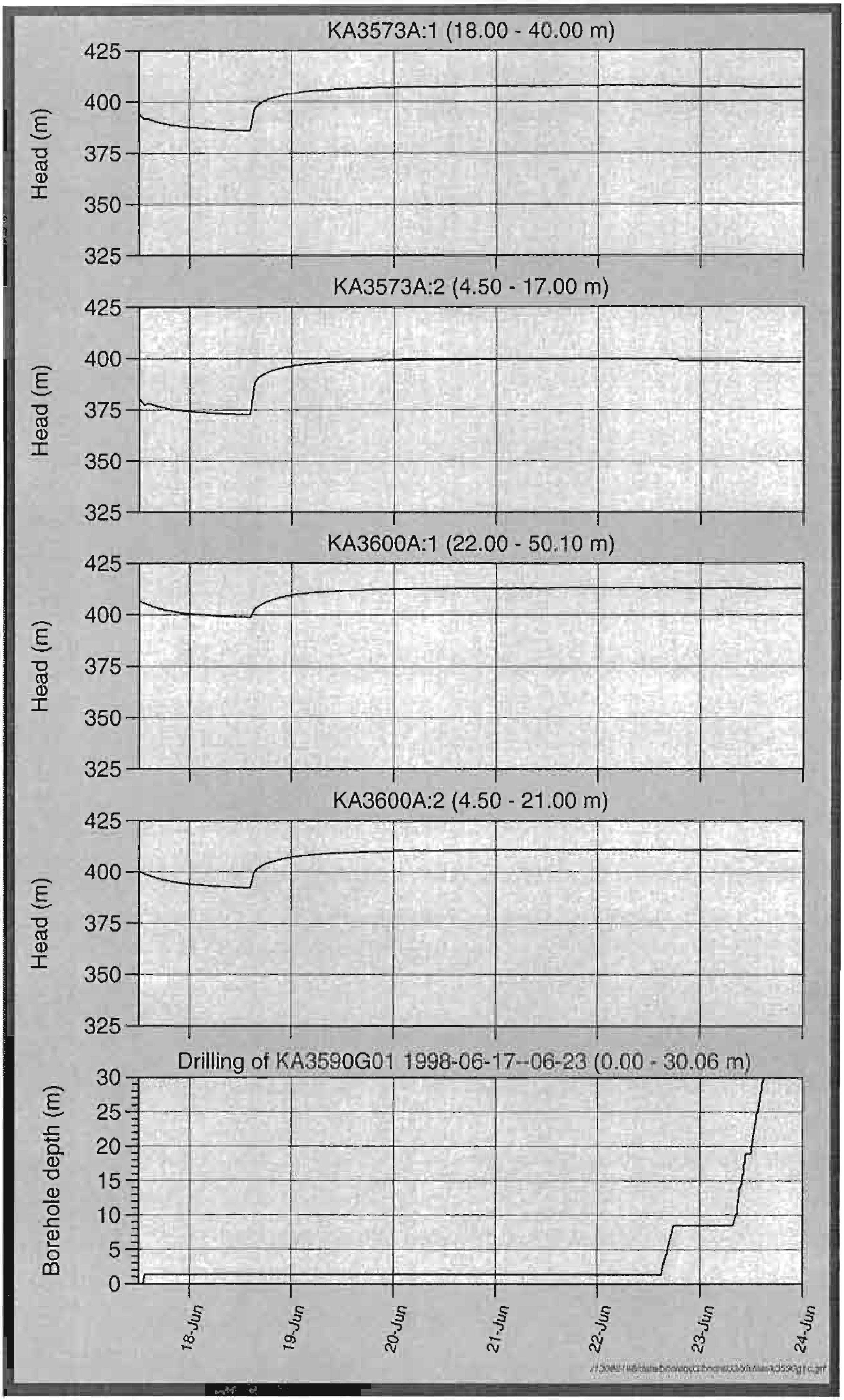

KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3573A:2 (4.50 - 21.00 m)
Drilling of KA3576G01 1998-04-25--04-26 (0.00 - 12.01 m)
Head (m)
Head (m)
Head (m)
Borehole depth (m)
425
400
375
350
325
12
10
8
6
4
2
0
0:00
6:00
12:00
18:00
0:00
6:00
12:00

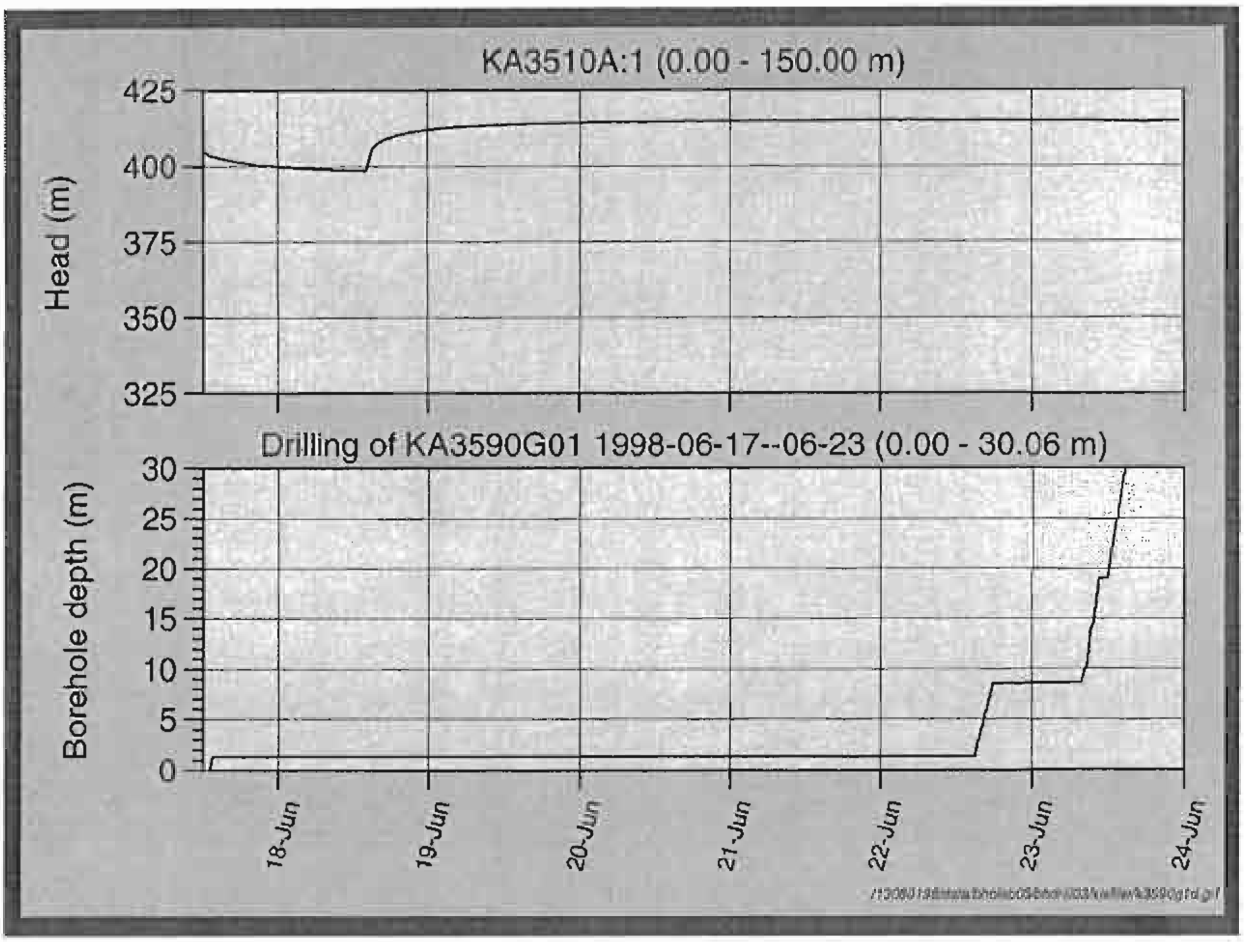


KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3576G01 1998-04-25--04-26 (0.00 - 12.01 m)
Borehole depth (m)
12
10
8
6
4
2
0
0:00
6:00
12:00
18:00
0:00
6:00
12:00

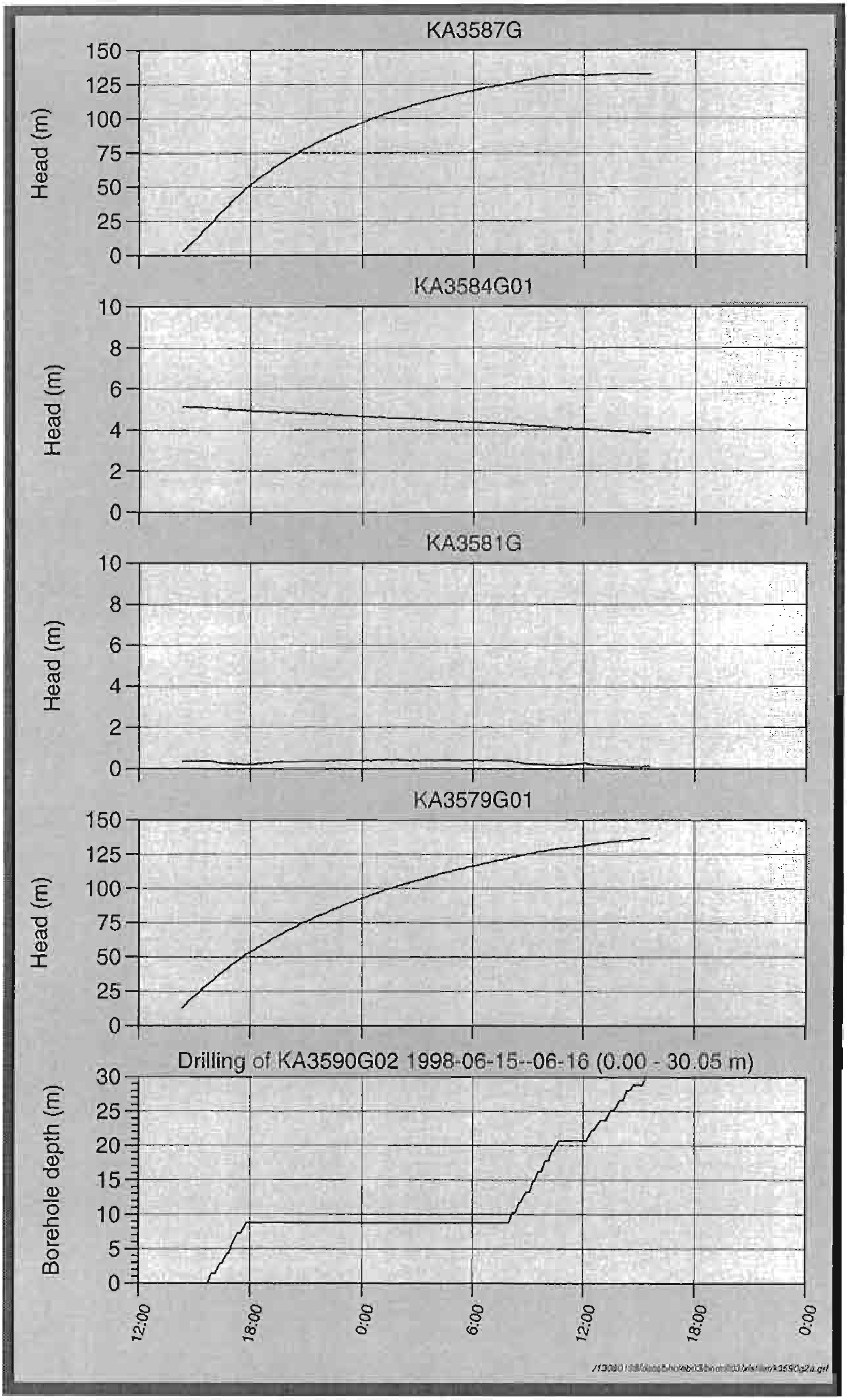

KA3587G
Head (m)
KA3584G01
Head (m)
KA3581G
Head (m)
KA3579G01
Head (m)
Drilling of KA3590G01 1998-06-17--06-23 (0.00 - 30.06 m)
Borehole depth (m)
18-Jun
19-Jun
20-Jun
21-Jun
22-Jun
23-Jun
24-Jun

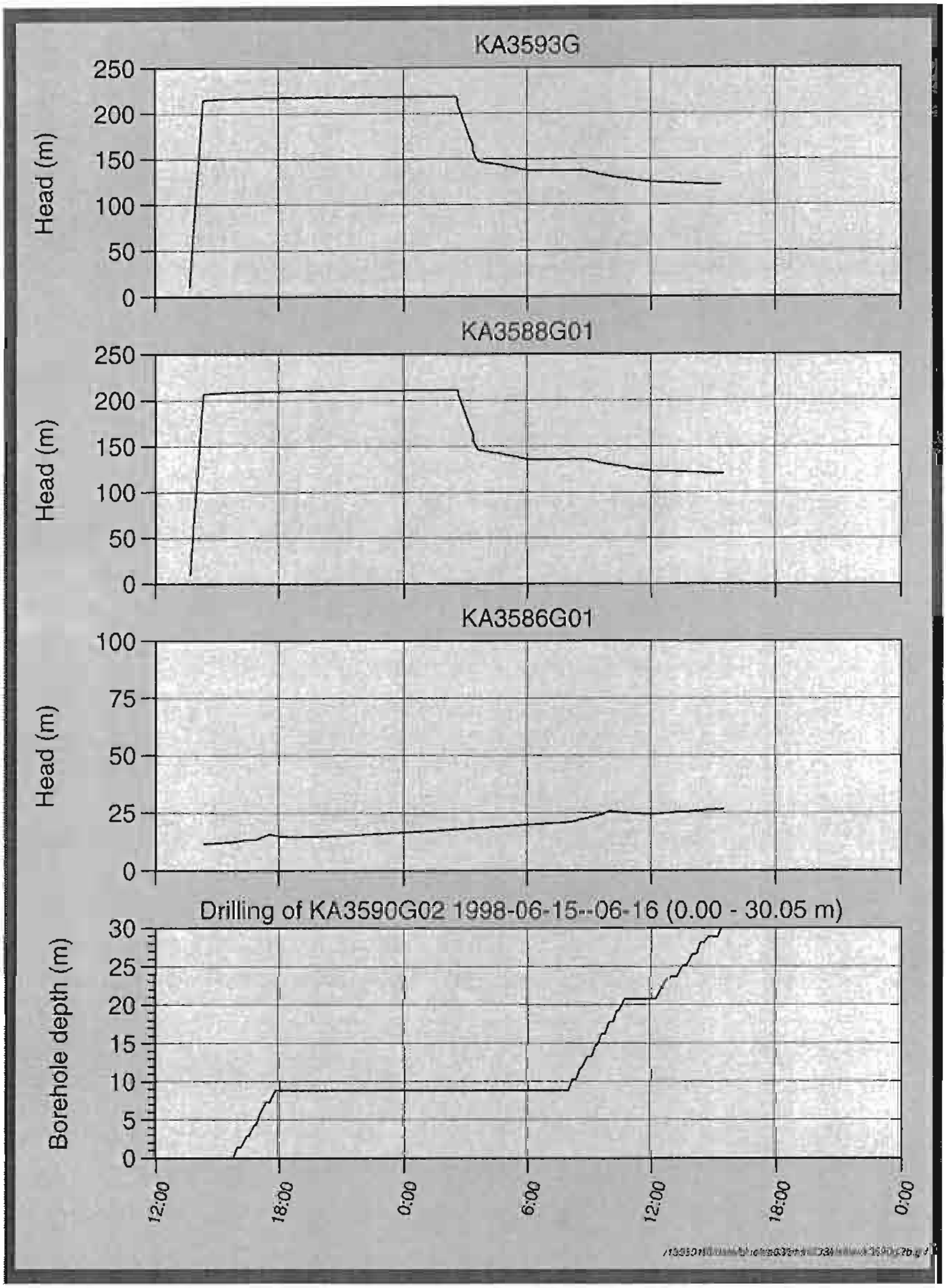

KA3593G
KA3588G01
KA3586G01
Drilling of KA3590G01 1998-06-17--06-23 (0.00 - 30.06 m)
Head (m)
Borehole depth (m)
18-Jun
19-Jun
20-Jun
21-Jun
22-Jun
23-Jun
24-Jun


KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Drilling of KA3590G01 1998-06-17--06-23 (0.00 - 30.06 m)
Head (m)
Borehole depth (m)
425
400
375
350
325
30
25
20
15
10
5
0
18-Jun
19-Jun
20-Jun
21-Jun
22-Jun
23-Jun
24-Jun

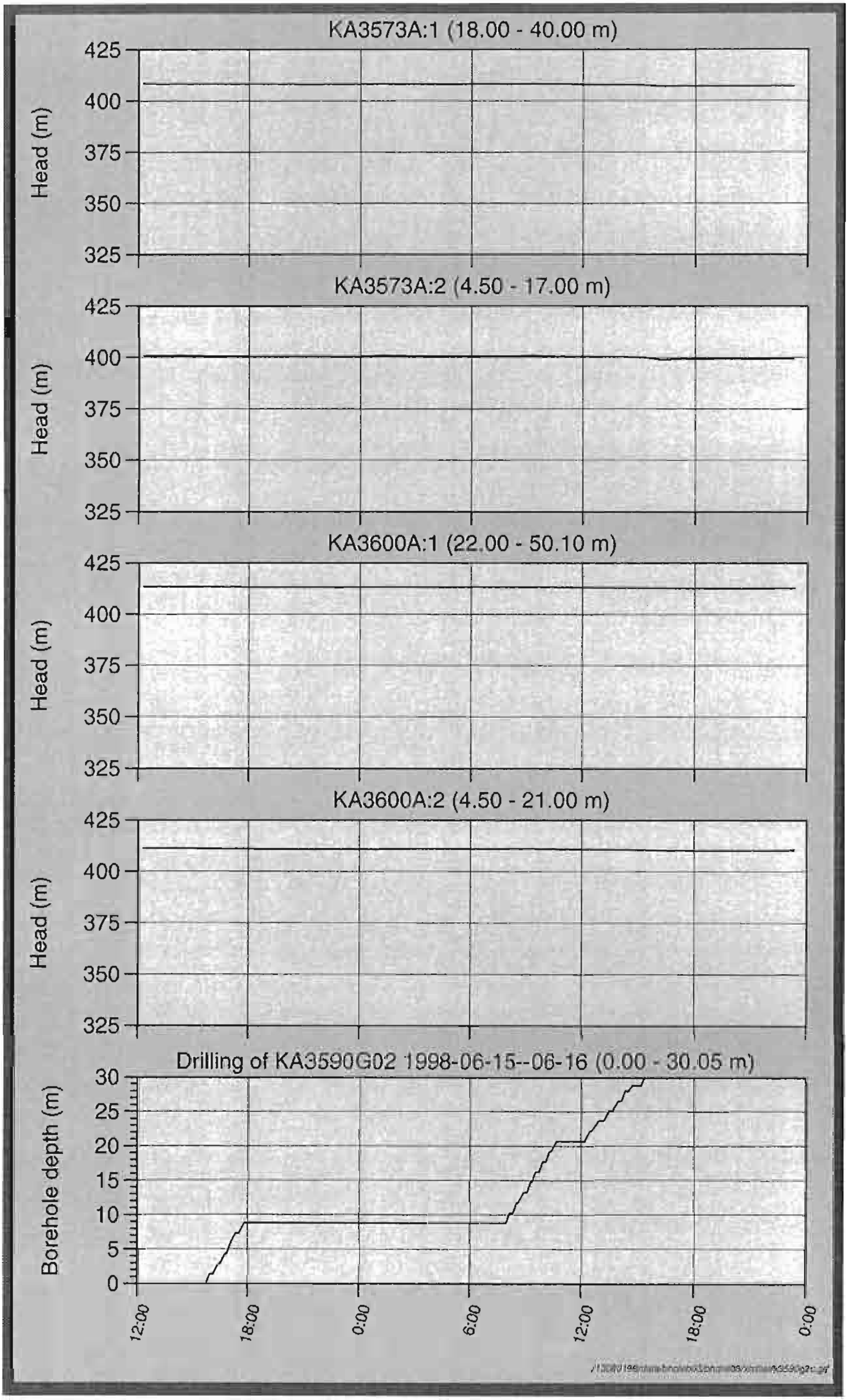


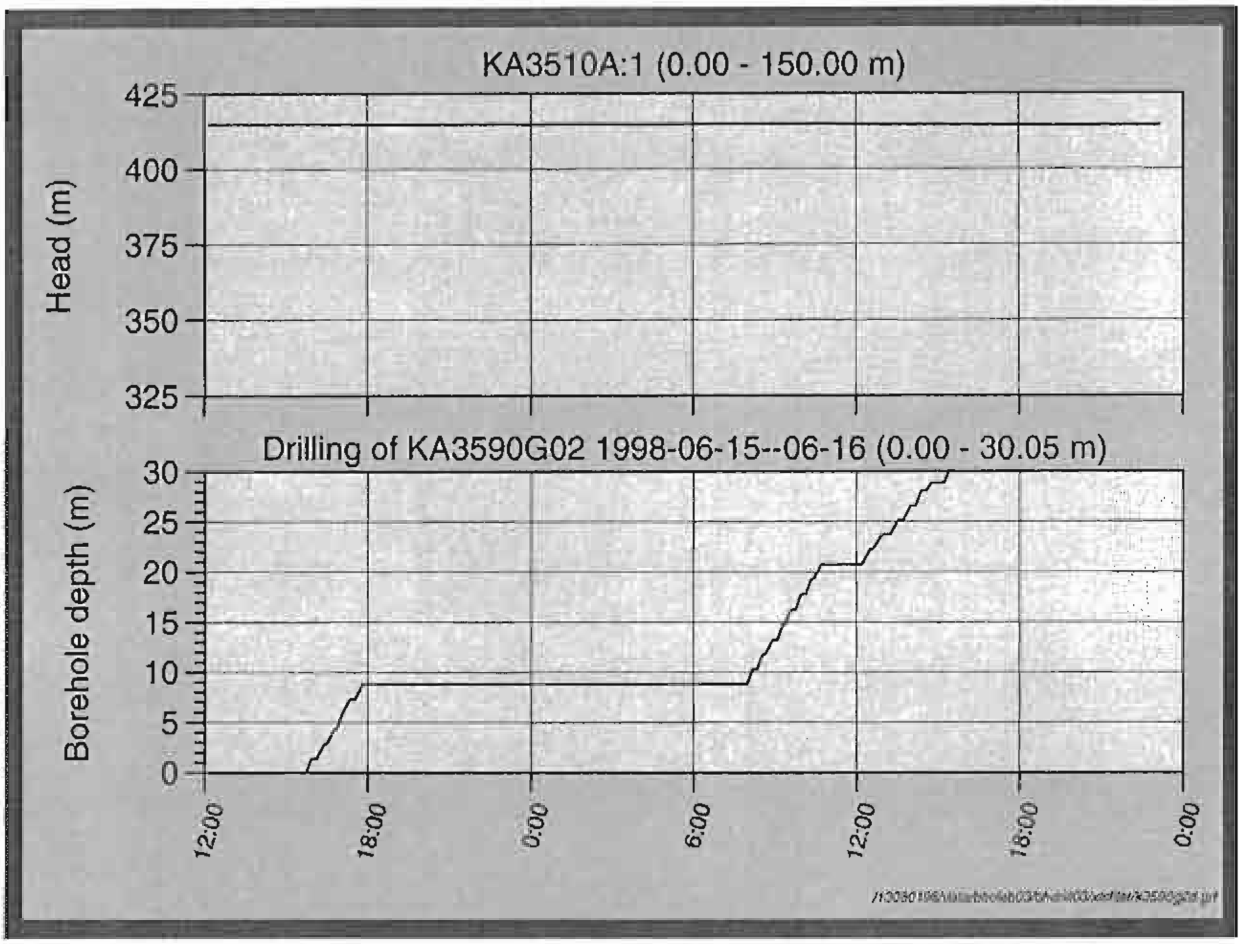
KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3590G01 1998-06-17--06-23 (0.00 - 30.06 m)
Borehole depth (m)
30
25
20
15
10
5
0
18-Jun
19-Jun
20-Jun
21-Jun
22-Jun
23-Jun
24-Jun

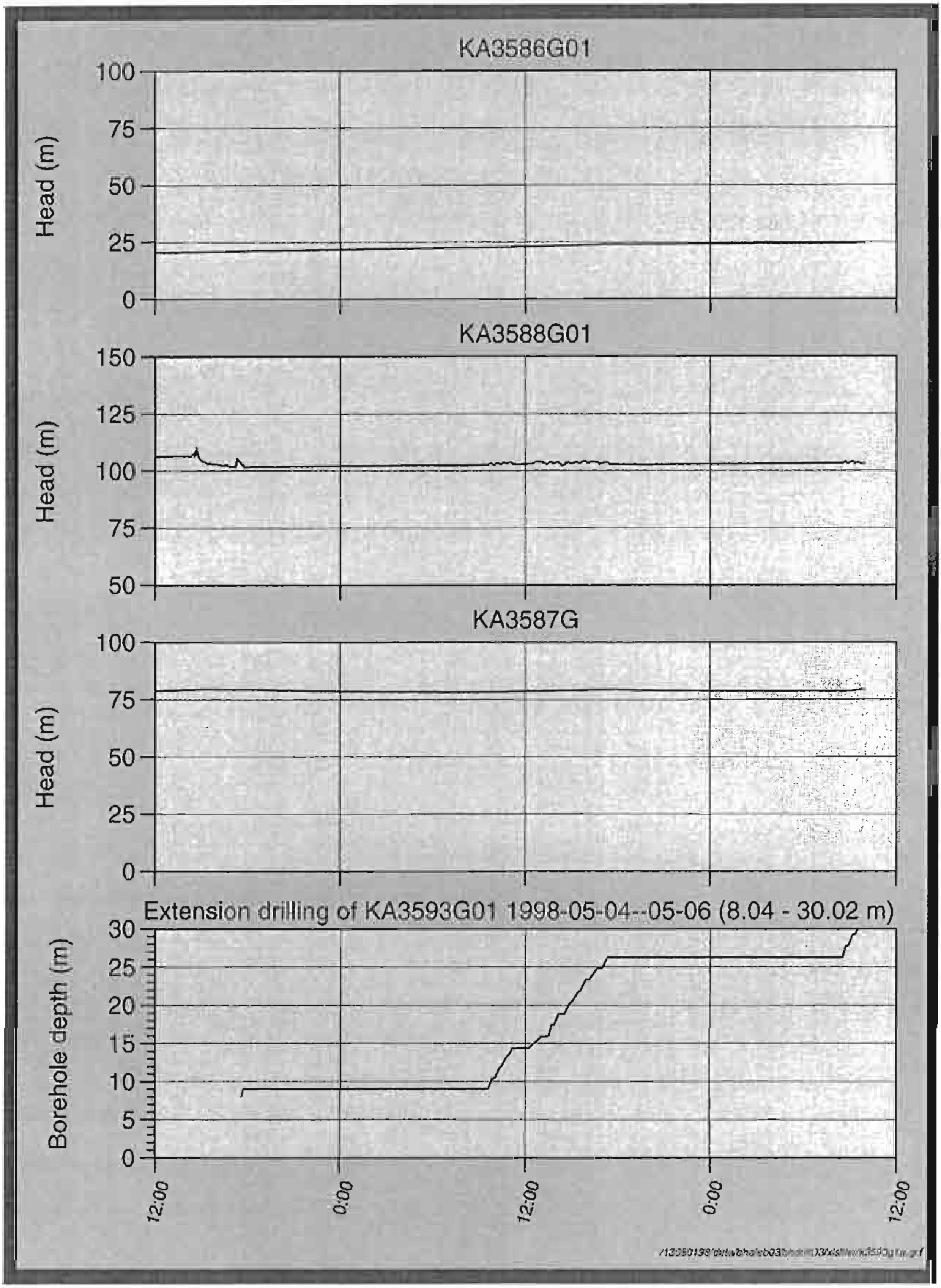

KA3587G
Head (m)
KA3584G01
Head (m)
KA3581G
Head (m)
KA3579G01
Head (m)
Drilling of KA3590G02 1998-06-15--06-16 (0.00 - 30.05 m)
Borehole depth (m)
12:00
18:00
0:00
6:00
12:00
18:00
0:00

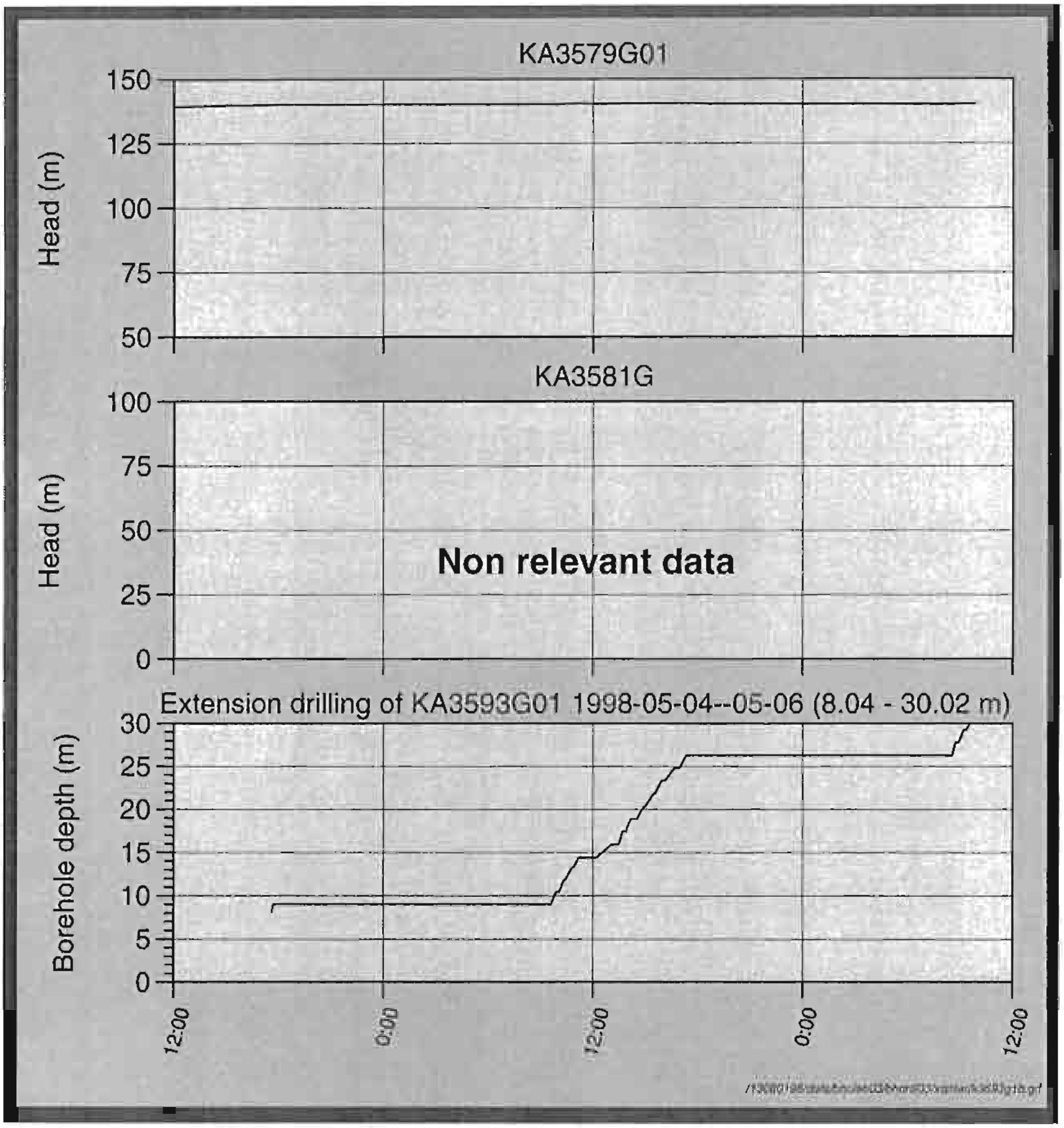


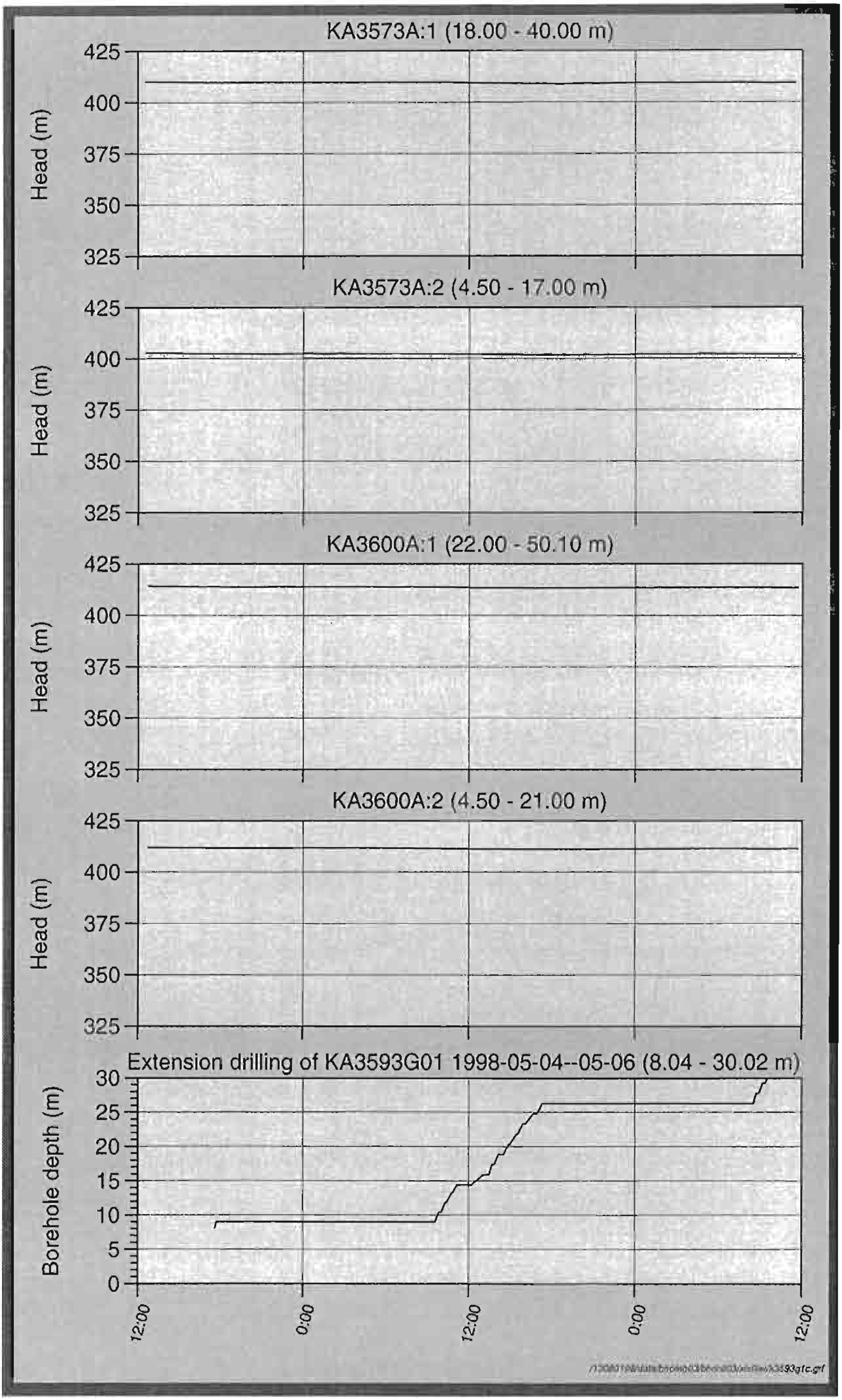
KA3593G
Head (m)
250
200
150
100
50
0
KA3588G01
Head (m)
250
200
150
100
50
0
KA3586G01
Head (m)
100
75
50
25
0
Drilling of KA3590G02 1998-06-15--06-16 (0.00 - 30.05 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

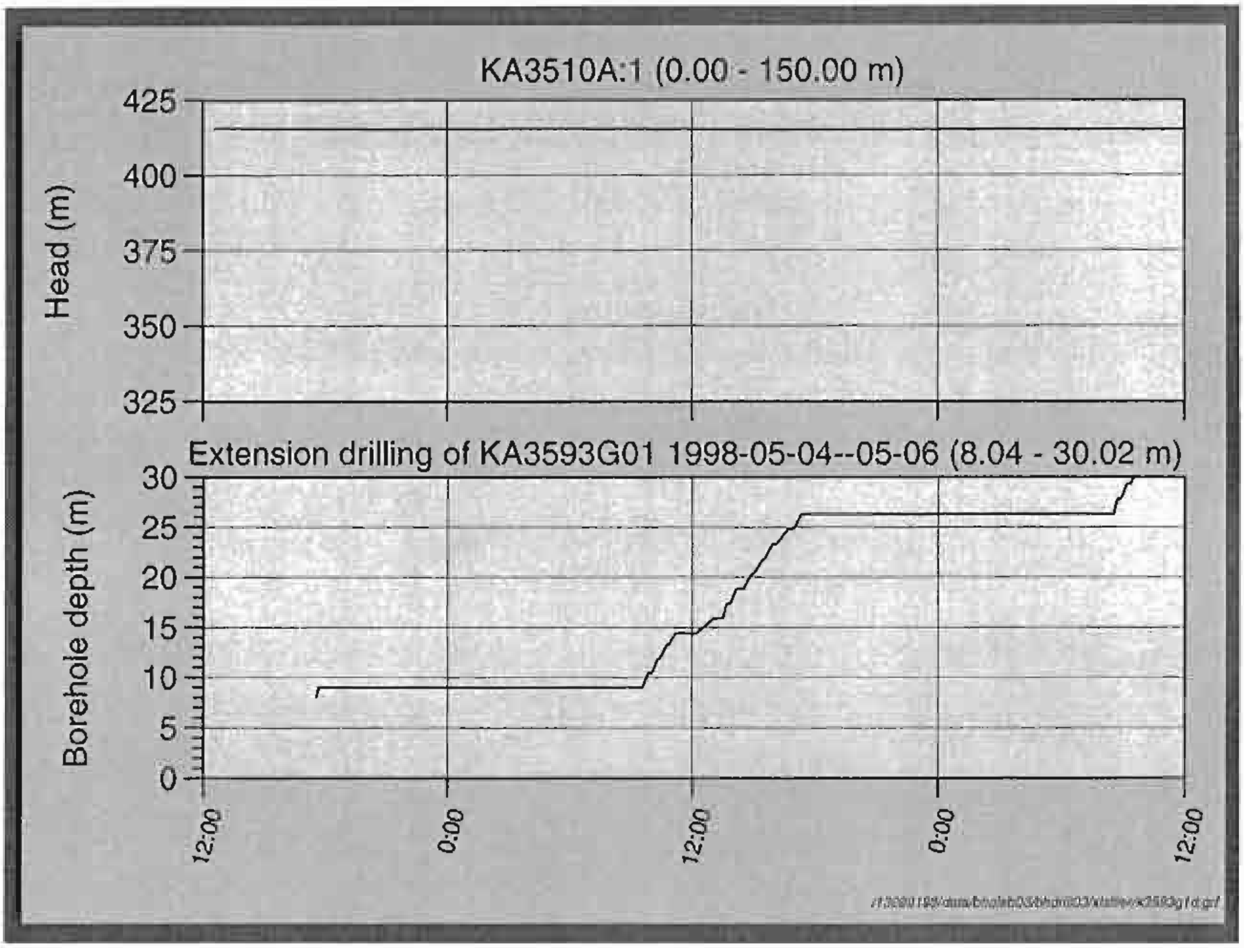

KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3590G02 1998-06-15--06-16 (0.00 - 30.05 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00


KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KA3590G02 1998-06-15--06-16 (0.00 - 30.05 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
18:00
0:00
6:00
12:00
18:00
0:00

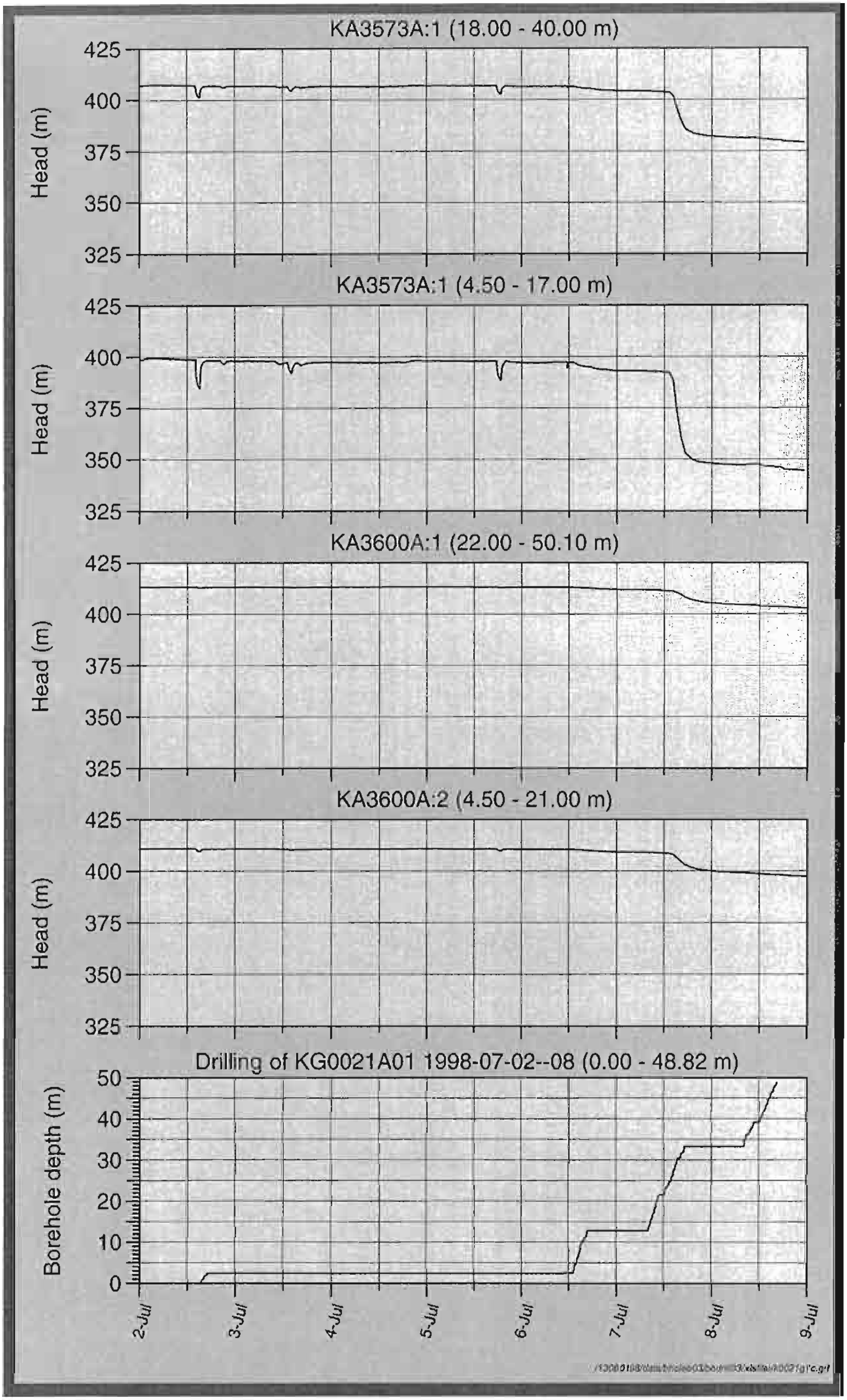

KA3586G01
Head (m)
100
75
50
25
0
KA3588G01
Head (m)
150
125
100
75
50
KA3587G
Head (m)
100
75
50
25
0
Extension drilling of KA3593G01 1998-05-04--05-06 (8.04 - 30.02 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
0:00
12:00
0:00
12:00

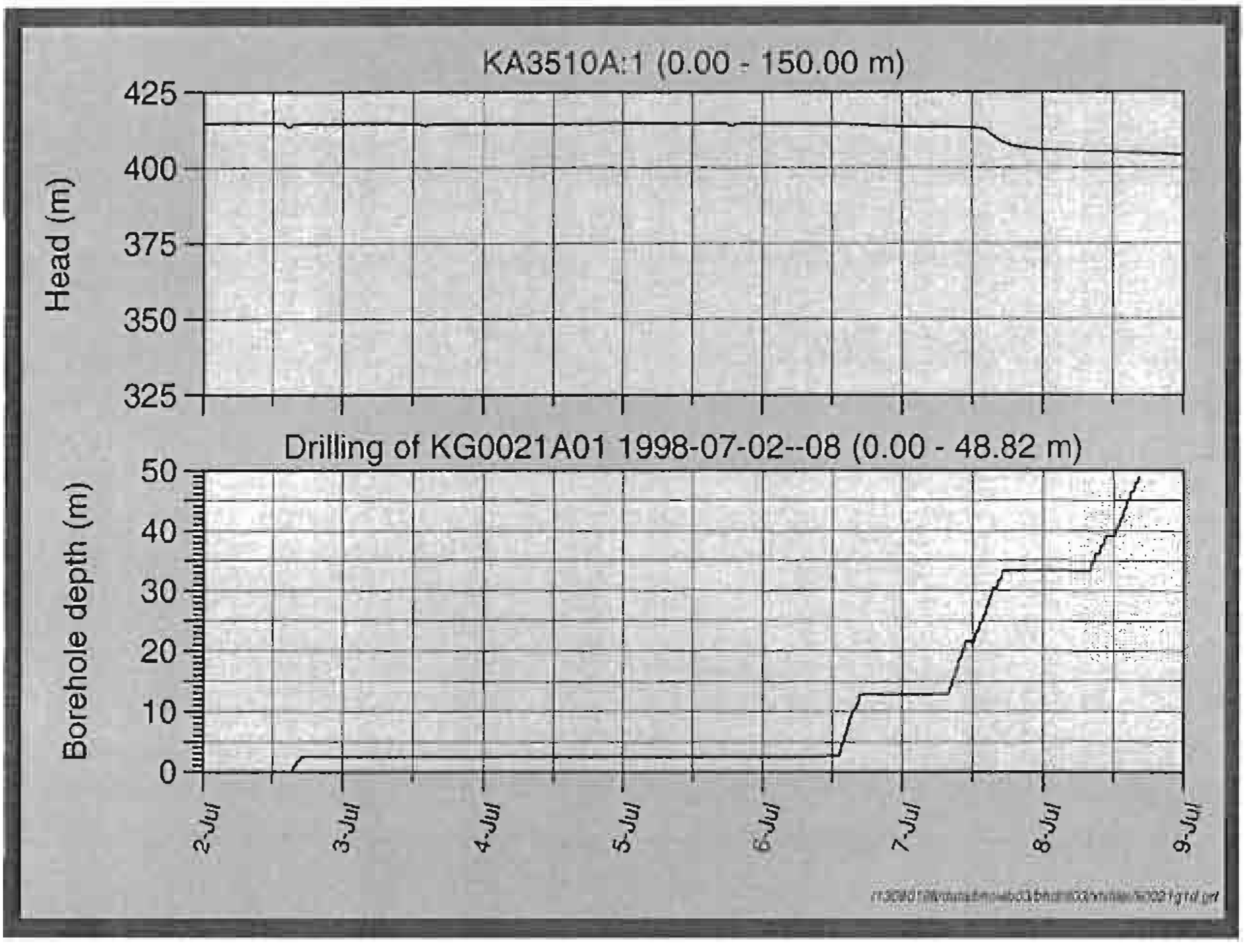

KA3579G01
Head (m)
150
125
100
75
50
KA3581G
Head (m)
100
75
50
25
0
Non relevant data
Extension drilling of KA3593G01 1998-05-04--05-06 (8.04 - 30.02 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
0:00
12:00
0:00
12:00


KA3573A:1 (18.00 - 40.00 m)
KA3573A:2 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Extension drilling of KA3593G01 1998-05-04--05-06 (8.04 - 30.02 m)
Head (m)
Borehole depth (m)
425
400
375
350
325
30
25
20
15
10
5
0
12:00
0:00
12:00
0:00
12:00

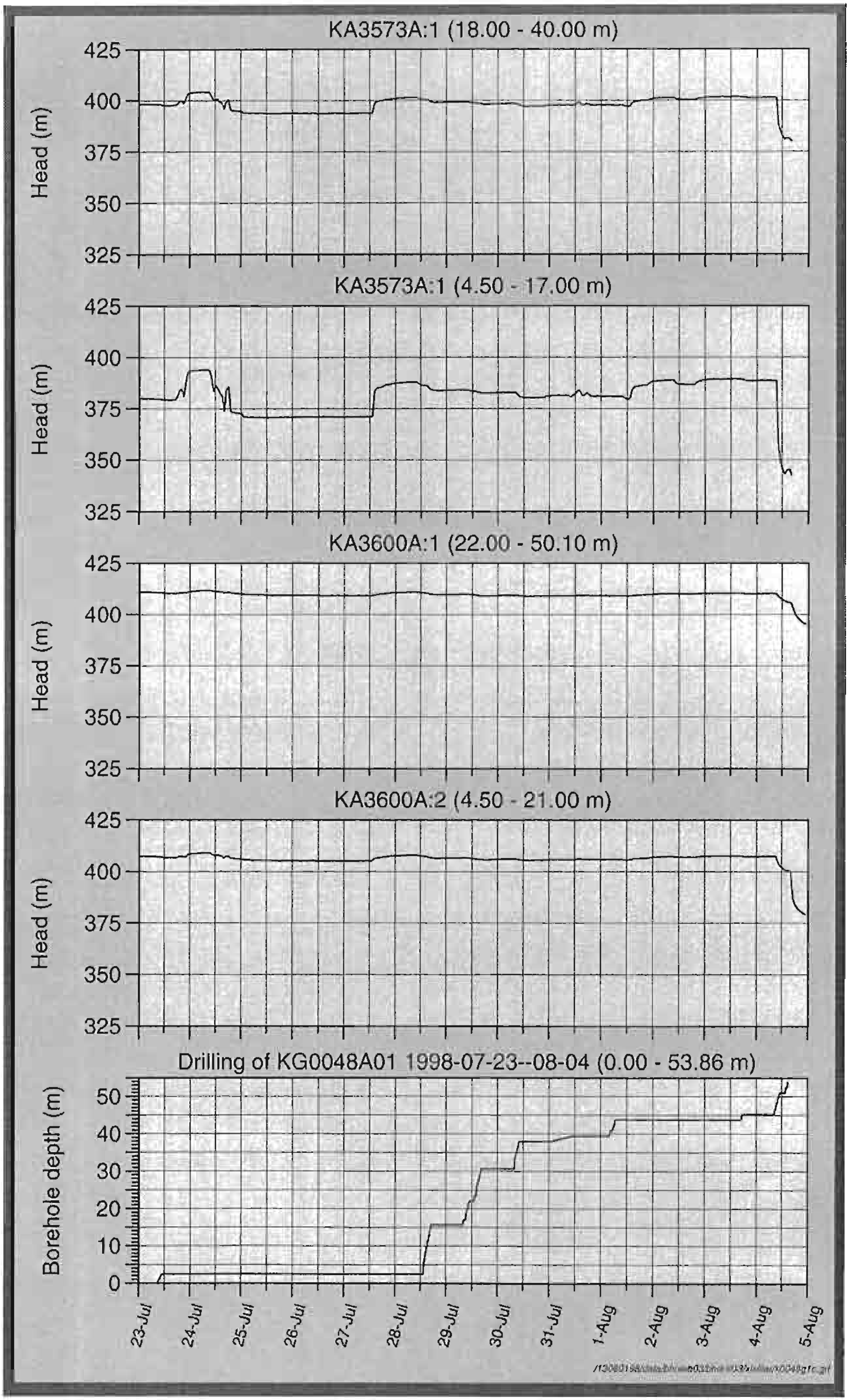


KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Extension drilling of KA3593G01 1998-05-04--05-06 (8.04 - 30.02 m)
Borehole depth (m)
30
25
20
15
10
5
0
12:00
0:00
12:00
0:00
12:00

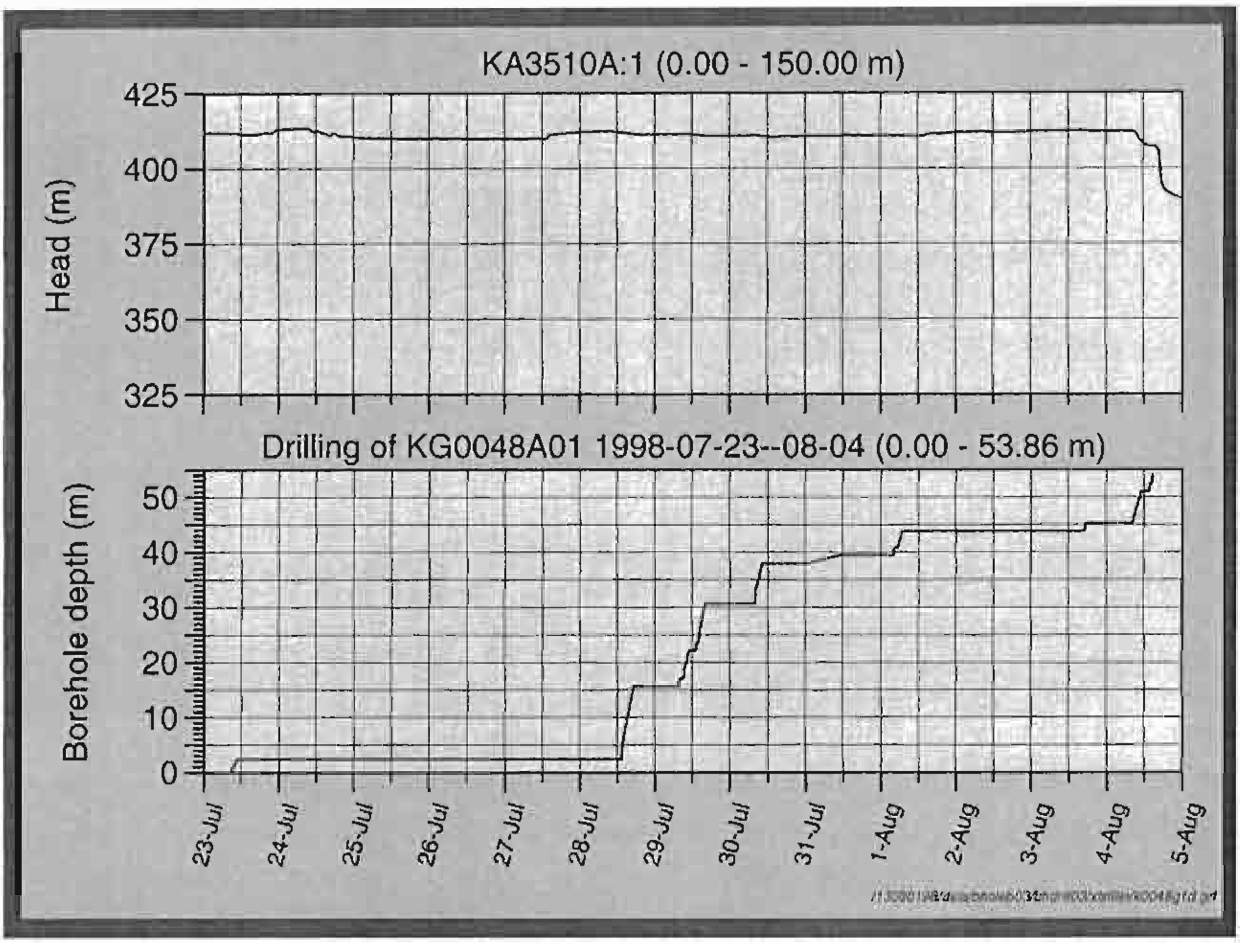

KA3573A:1 (18.00 - 40.00 m)
KA3573A:1 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Drilling of KG0021A01 1998-07-02--08 (0.00 - 48.82 m)
Head (m)
Borehole depth (m)
425
400
375
350
325
50
40
30
20
10
0
2-Jul
3-Jul
4-Jul
5-Jul
6-Jul
7-Jul
8-Jul
9-Jul



KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KG0021A01 1998-07-02--08 (0.00 - 48.82 m)
Borehole depth (m)
50
40
30
20
10
0
2-Jul
3-Jul
4-Jul
5-Jul
6-Jul
7-Jul
8-Jul
9-Jul



KA3573A:1 (18.00 - 40.00 m)
KA3573A:1 (4.50 - 17.00 m)
KA3600A:1 (22.00 - 50.10 m)
KA3600A:2 (4.50 - 21.00 m)
Head (m)
425
400
375
350
325
Drilling of KG0048A01 1998-07-23--08-04 (0.00 - 53.86 m)
Borehole depth (m)
50
40
30
20
10
0
23-Jul
24-Jul
25-Jul
26-Jul
27-Jul
28-Jul
29-Jul
30-Jul
31-Jul
1-Aug
2-Aug
3-Aug
4-Aug
5-Aug

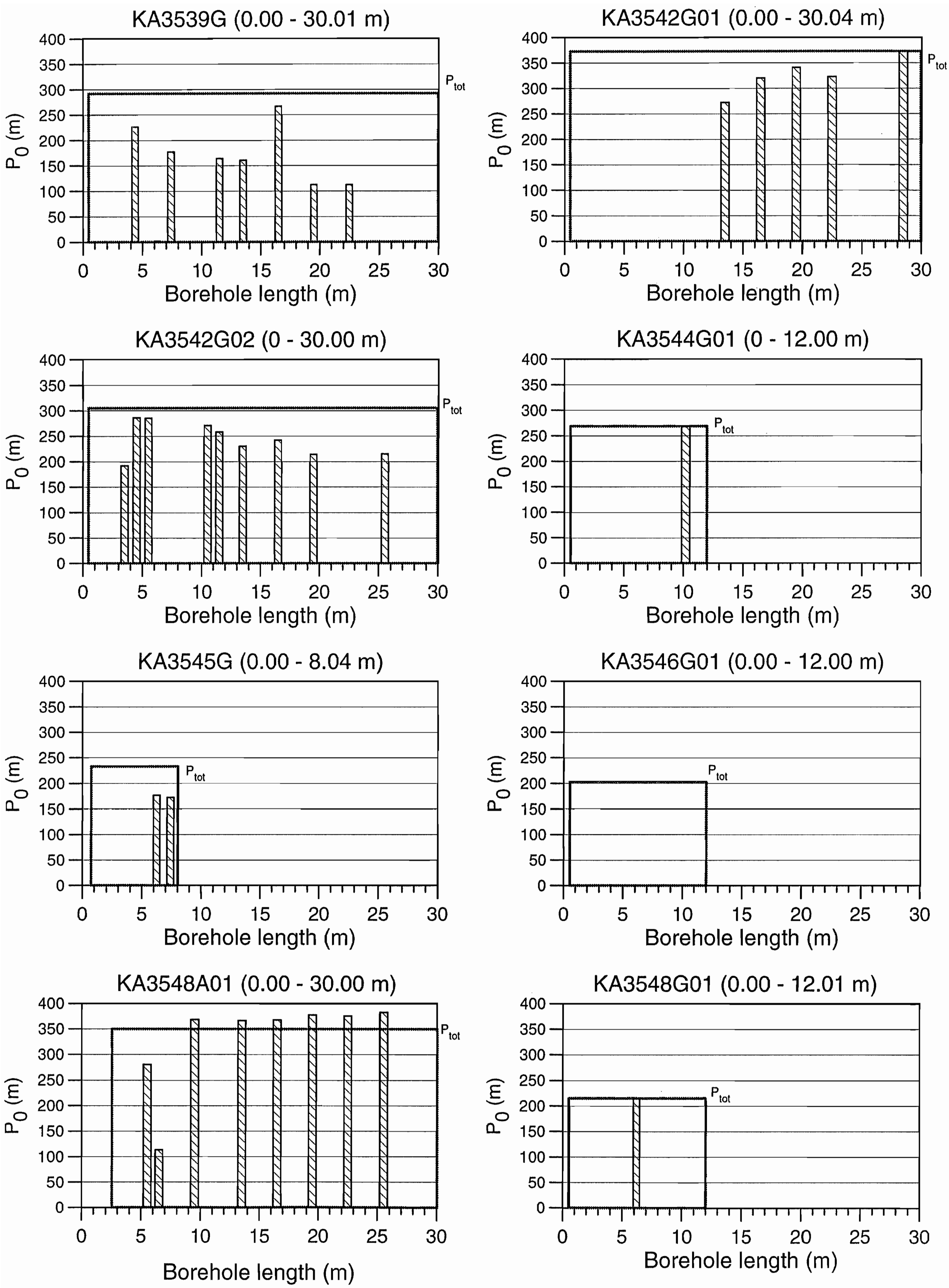


KA3510A:1 (0.00 - 150.00 m)
Head (m)
425
400
375
350
325
Drilling of KG0048A01 1998-07-23--08-04 (0.00 - 53.86 m)
Borehole depth (m)
50
40
30
20
10
0
23-Jul
24-Jul
25-Jul
26-Jul
27-Jul
28-Jul
29-Jul
30-Jul
31-Jul
1-Aug
2-Aug
3-Aug
4-Aug
5-Aug

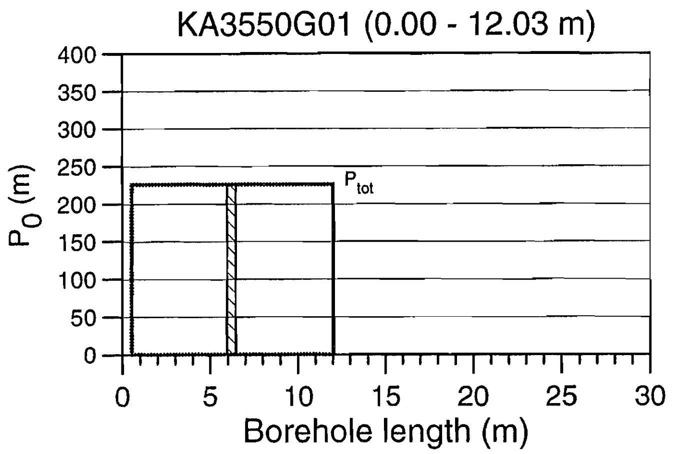
APPENDIX 2

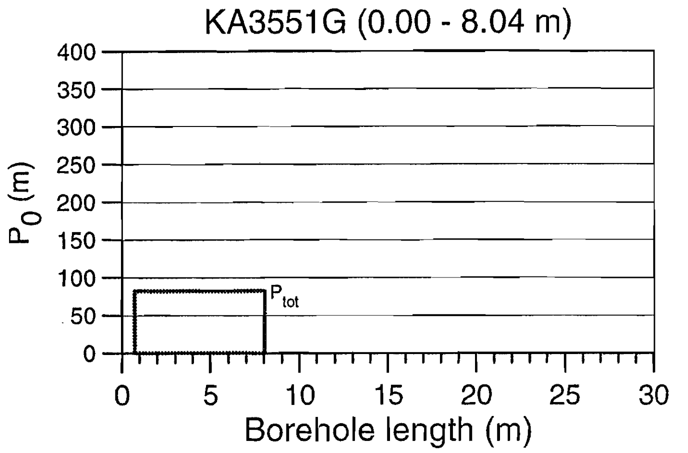
Undisturbed pressure

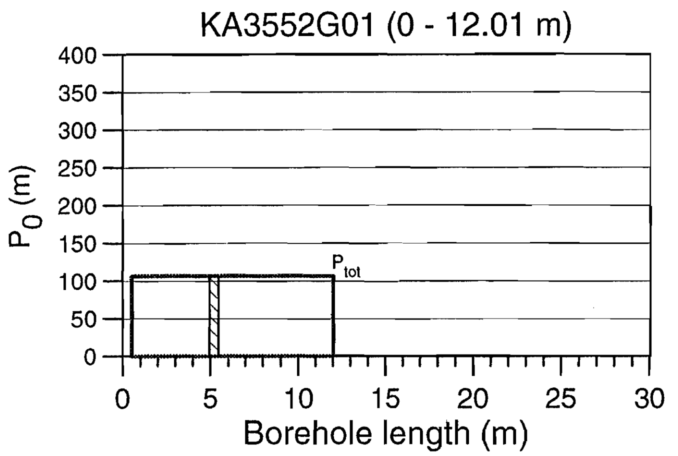
- KA3539G, 0.00 - 30.01 m
- KA3542G01, 0.00 - 30.04 m
- KA3542G02, 0.00 - 30.01 m
- KA3544G01, 0.00 - 12.00 m
- KA3545G, 0.00 - 8.04 m
- KA3546G01, 0.00 - 12.00 m
- KA3548A01, 0.00 - 30.00 m
- KA3548G01, 0.00 - 12.01 m
- KA3550G01, 0.00 - 12.03 m
- KA3551G, 0.00 - 8.04 m
- KA3552G01, 0.00 - 12.01 m
- KA3554G01, 0.00 - 30.01 m
- KA3554G02, 0.00 - 30.01 m
- KA3557G, 0.00 - 30.04 m
- KA3563G, 0.00 - 30.00 m
- KA3566G01, 0.00 - 30.01 m
- KA3566G02, 0.00 - 30.01 m
- KA3569G, 0.00 - 8.04 m
- KA3572G01, 0.00 - 12.00 m
- KA3574G01, 0.00 - 12.00 m
- KA3575G, 0.00 - 8.04 m
- KA3576G01, 0.00 - 12.01 m
- KA3578G01, 0.00 - 12.58 m
- KA3579G01, 0.00 - 22.65 m
- KA3581G, 0.00 - 8.04 m
- KA3584G01, 0.00 - 12.00 m
- KA3586G01, 0.00 - 8.00 m
- KA3587G, 0.00 - 8.04 m
- KA3588G01, 0.00 - 8.00 m
- KA3590G01, 0.00 - 30.06 m
- KA3590G02, 0.00 - 30.05 m
- KA3593G01, 0.00 - 30.02 m
- KG0021A01, 0.00 - 48.82 m
- KG0048A01, 0.00 - 54.69 m

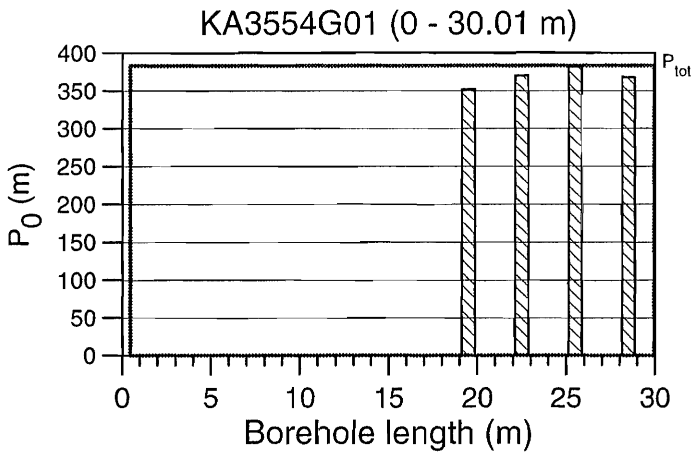


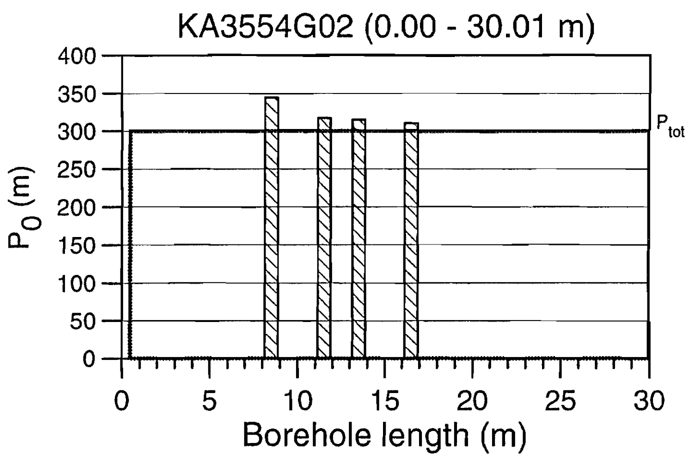
/1311/13080198/data/bholeb03/flow_03/p_01_tot.grf
04/21/99

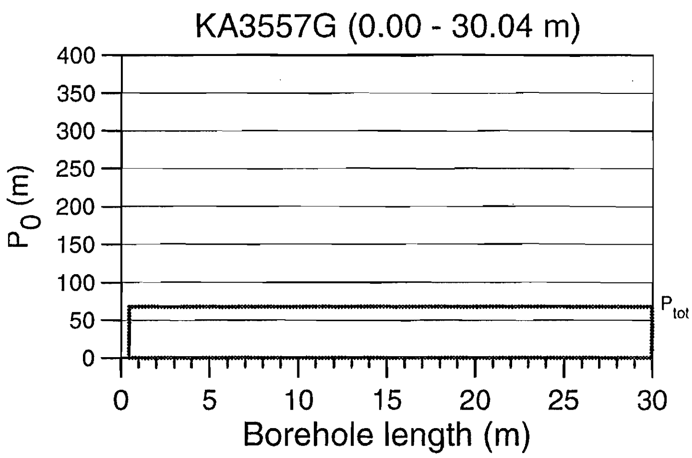

KA3550G01 (0.00 - 12.03 m)
P0 (m)
Ptot
Borehole length (m)

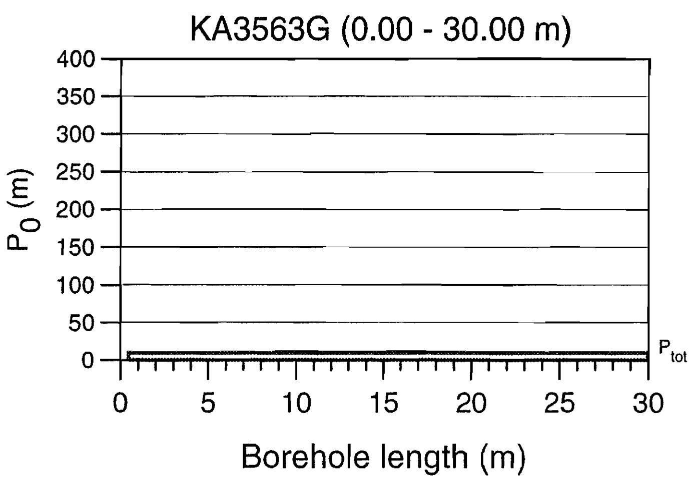

KA3551G (0.00 - 8.04 m)
P0 (m)
Ptot
Borehole length (m)

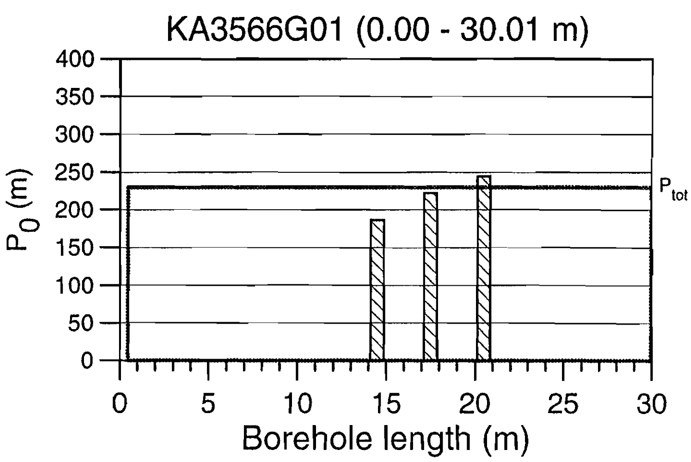

KA3552G01 (0 - 12.01 m)
P0 (m)
Ptot
Borehole length (m)

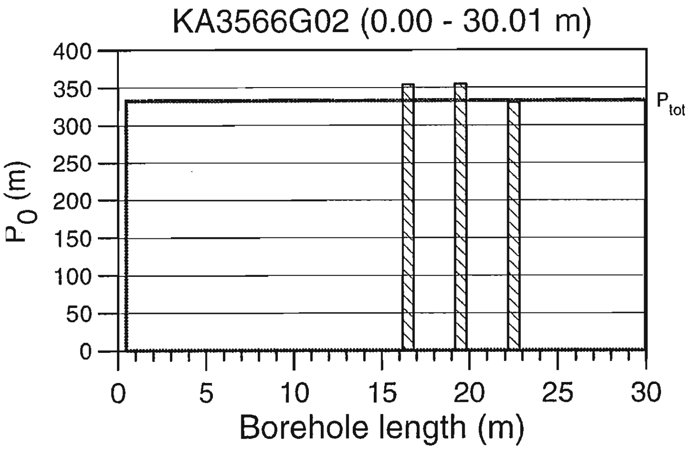

KA3554G01 (0 - 30.01 m)
P0 (m)
Ptot
Borehole length (m)

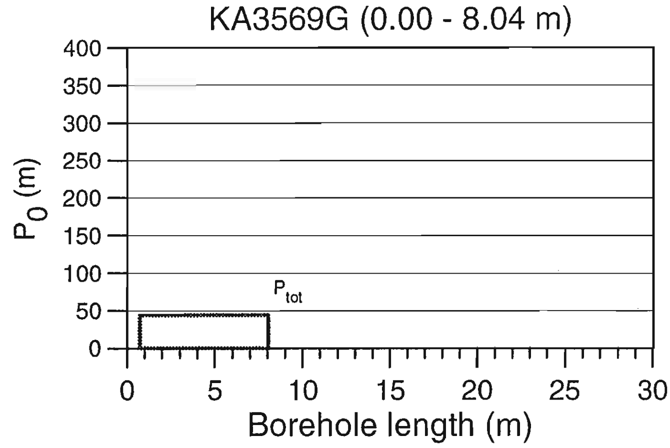

KA3554G02 (0.00 - 30.01 m)
P0 (m)
Ptot
Borehole length (m)

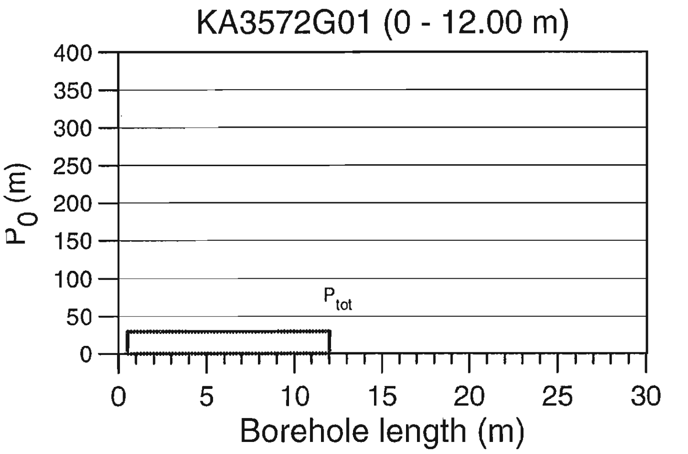

KA3557G (0.00 - 30.04 m)
P0 (m)
Ptot
Borehole length (m)

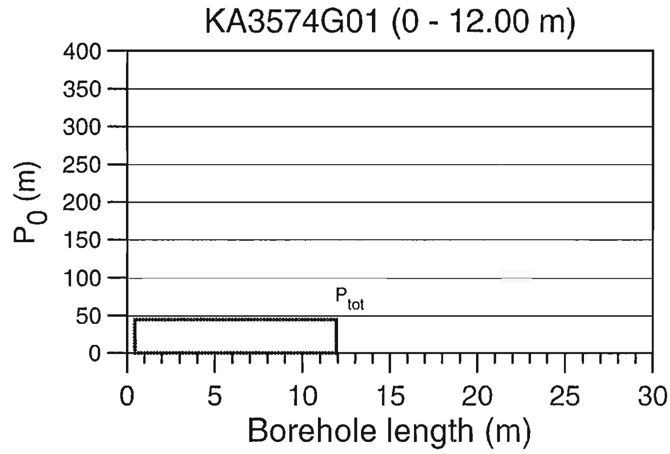

KA3563G (0.00 - 30.00 m)
P0 (m)
Ptot
Borehole length (m)

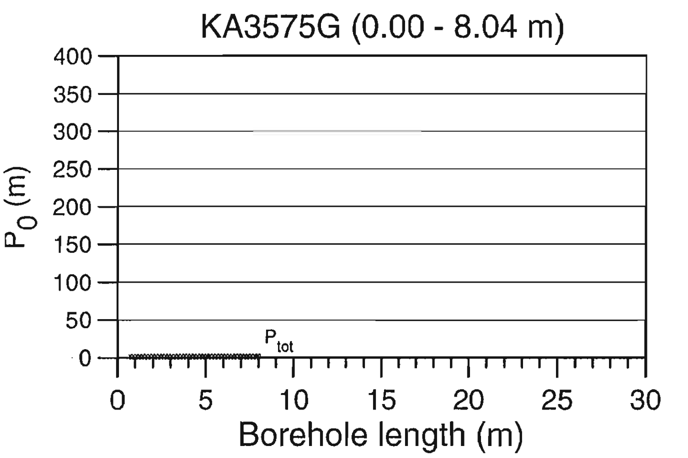

KA3566G01 (0.00 - 30.01 m)
P0 (m)
Ptot
Borehole length (m)

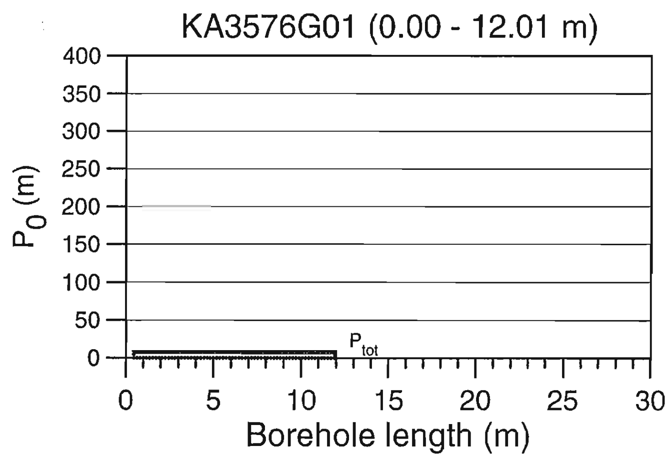


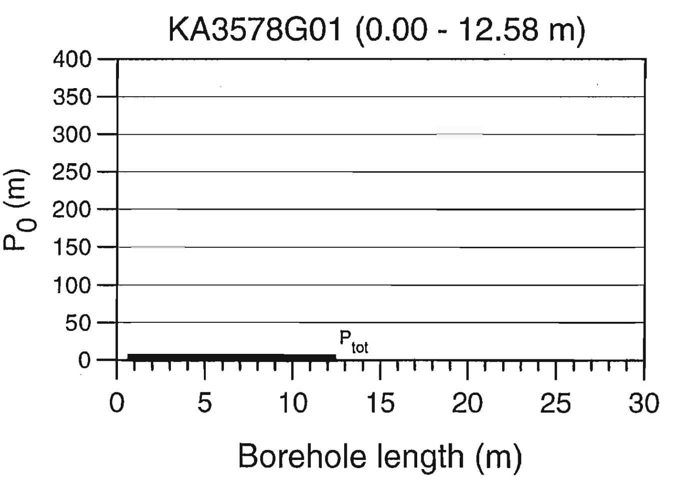


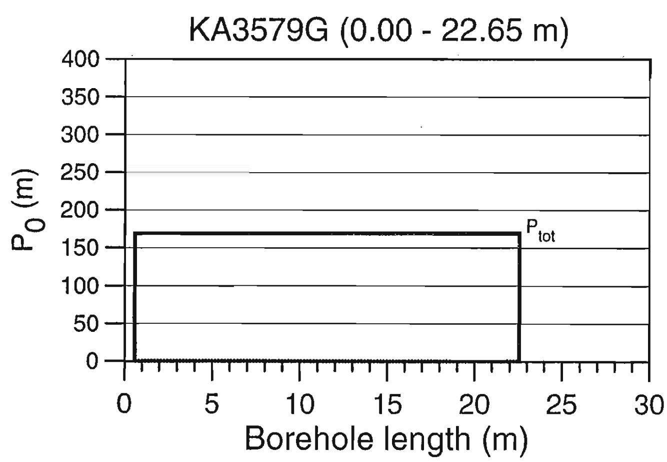






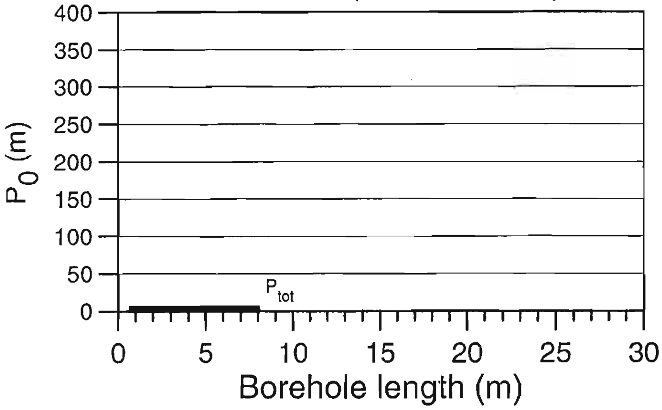




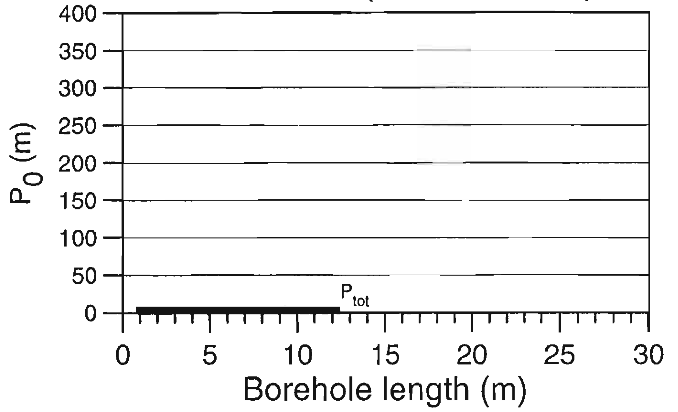


/1311/13080198/data/bholeb03/flow_03/p_03_tot.grf
04/21/99

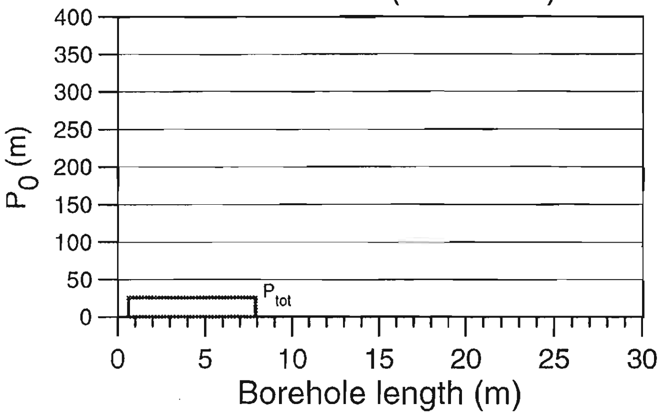
KA3581G (0.00 - 8.04 m)



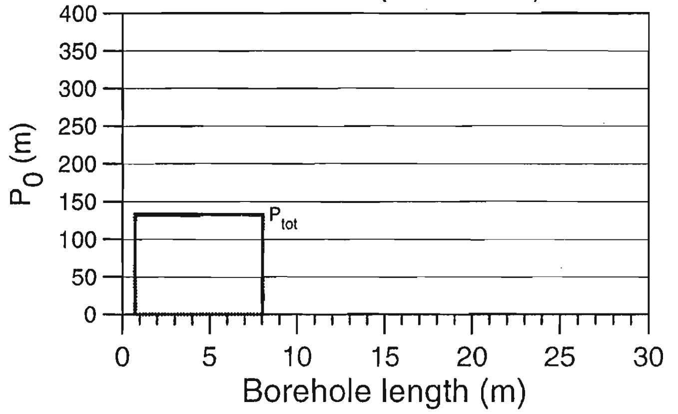
KA3584G01 (0.00 - 12.00 m)



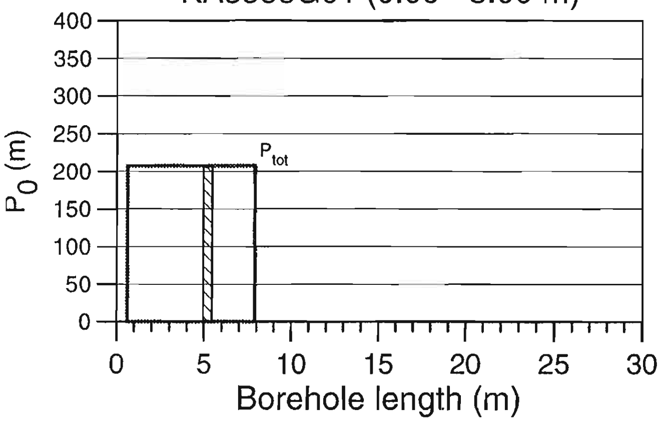
KA3586G01 (0 - 8.00 m)



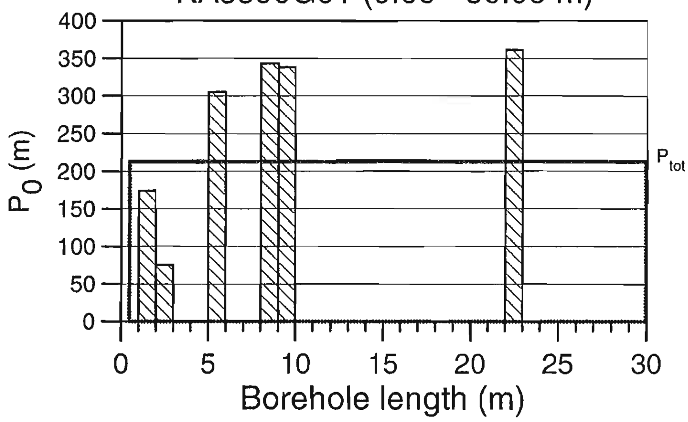
KA3587G (0 - 8.04 m)



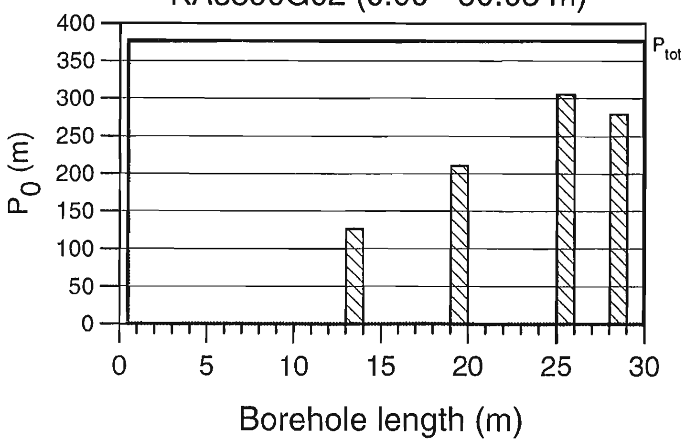
KA3588G01 (0.00 - 8.00 m)



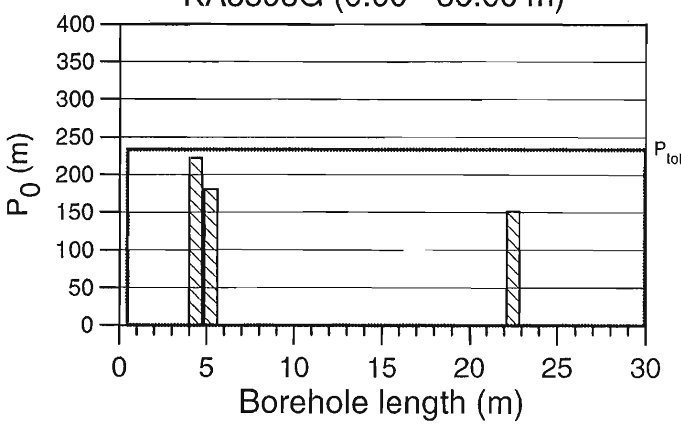
KA3590G01 (0.00 - 30.06 m)



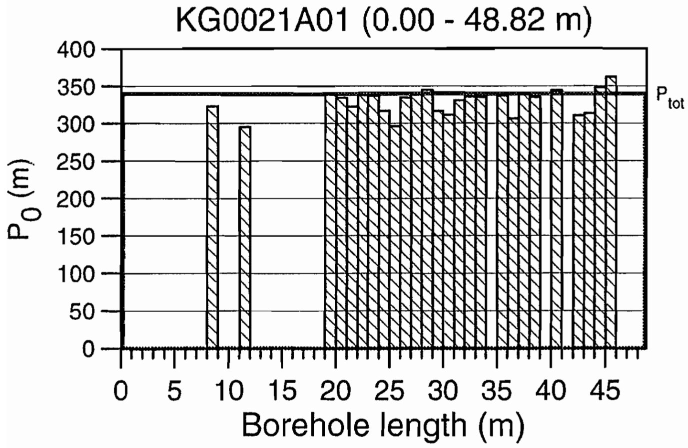
KA3590G02 (0.00 - 30.05 m)

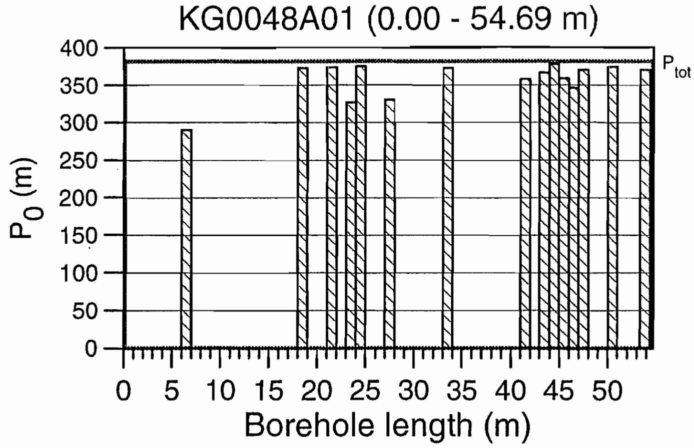


KA3593G (0.00 - 30.00 m)



/1311/13080198/data/bholeb03/flow_03/p_04_tot.grf
04/21/99



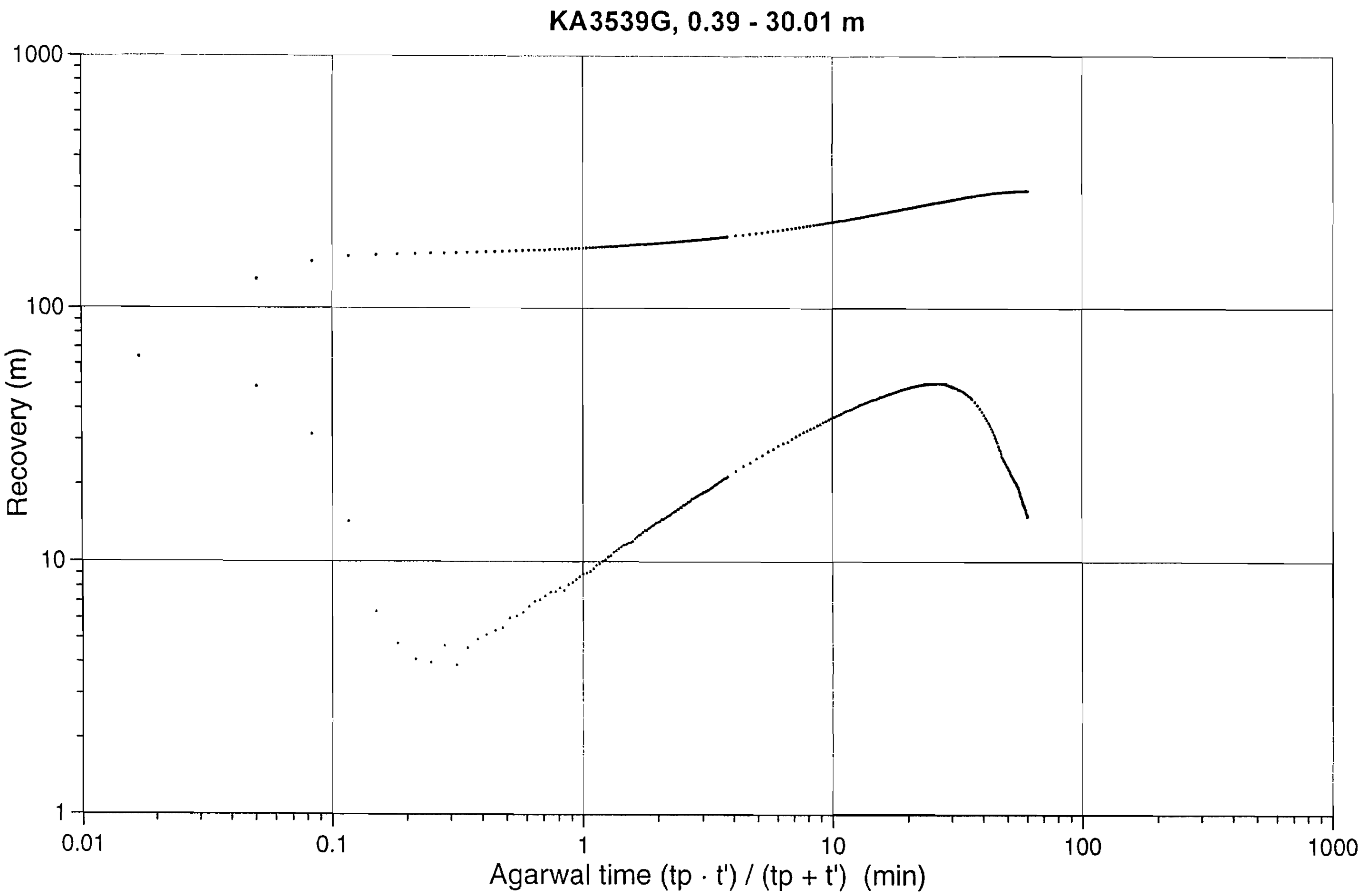


/1311/13080198/data/bholeb03/flow_03/p_05_tot.grf
04/21/99

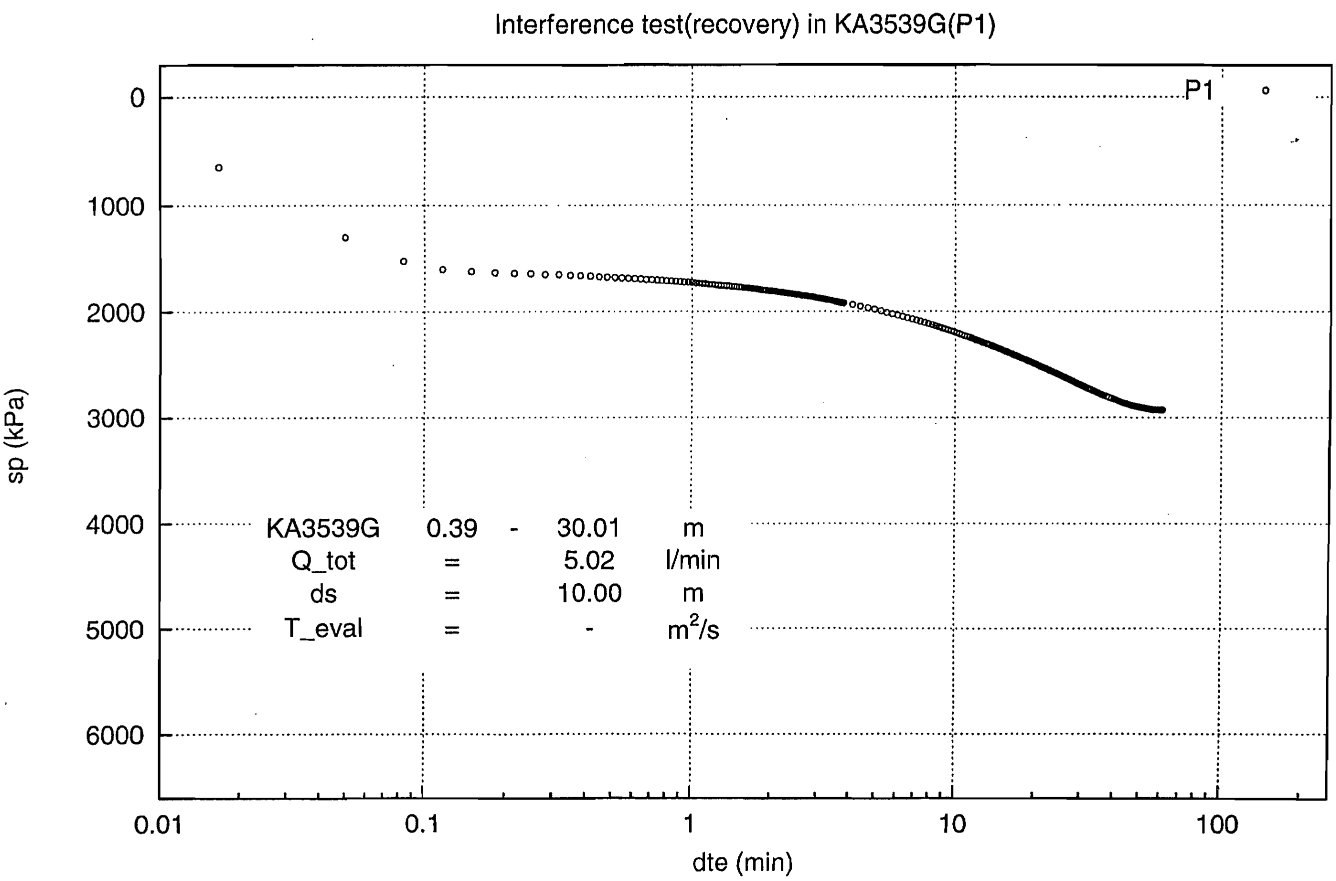
APPENDIX 3

Pressure build-up tests and interference tests in exploratory boreholes

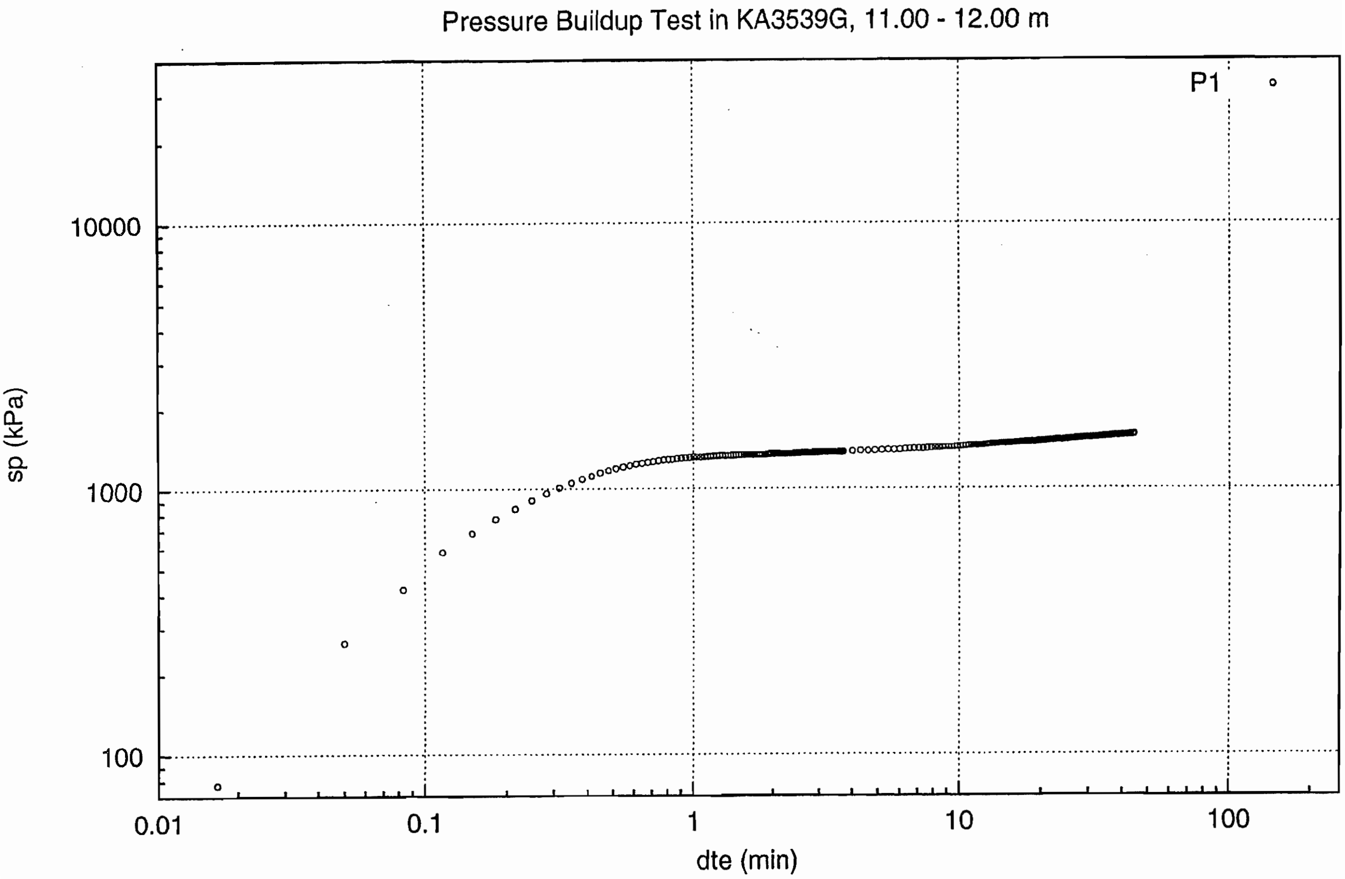
- KA3539G, 0.00 - 30.01 m
- KA3542G01, 0.00 - 30.04 m
- KA3542G02, 0.00 - 30.01 m
- KA3548A01, 0.00 - 30.00 m
- KA3554G01, 0.00 - 30.01 m
- KA3554G02, 0.00 - 30.01 m
- KA3557G, 0.00 - 30.04 m
- KA3563G, 0.00 - 30.00 m
- KA3566G01, 0.00 - 30.01 m
- KA3566G02, 0.00 - 30.01 m
- KA3574G01, 0.00 - 12.00 m
- KA3576G01, 0.00 - 12.01 m
- KA3579G01, 0.00 - 22.65 m
- KA3590G01, 0.00 - 30.06 m
- KA3590G02, 0.00 - 30.05 m
- KA3593G01, 0.00 - 30.02 m
- KG0021A01, 0.00 - 48.82 m
- KG0048A01, 0.00 - 54.69 m



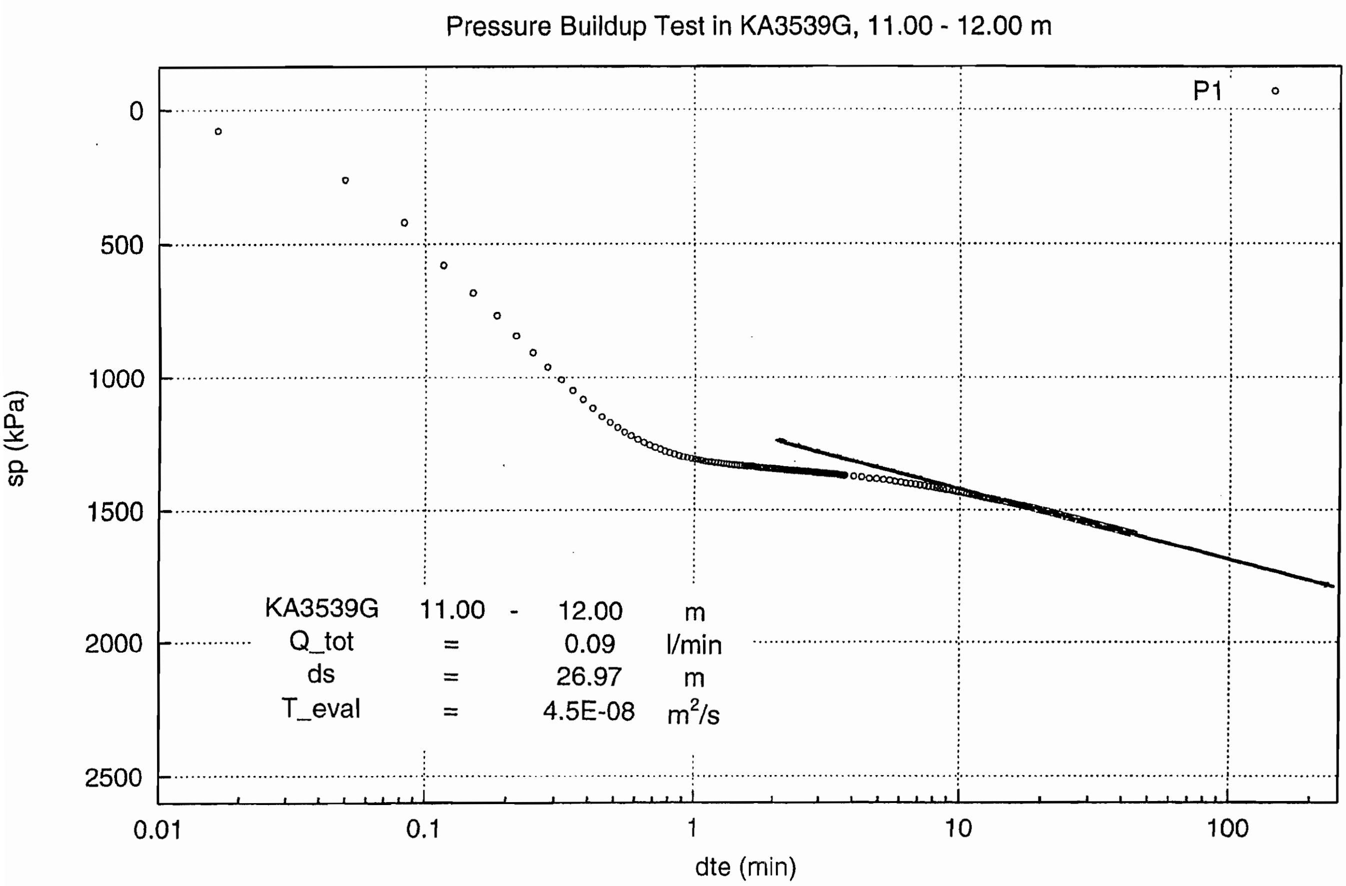
KA3539G, 0.39 - 30.01 m
Recovery (m)
Agarwal time (tp · t') / (tp + t') (min)



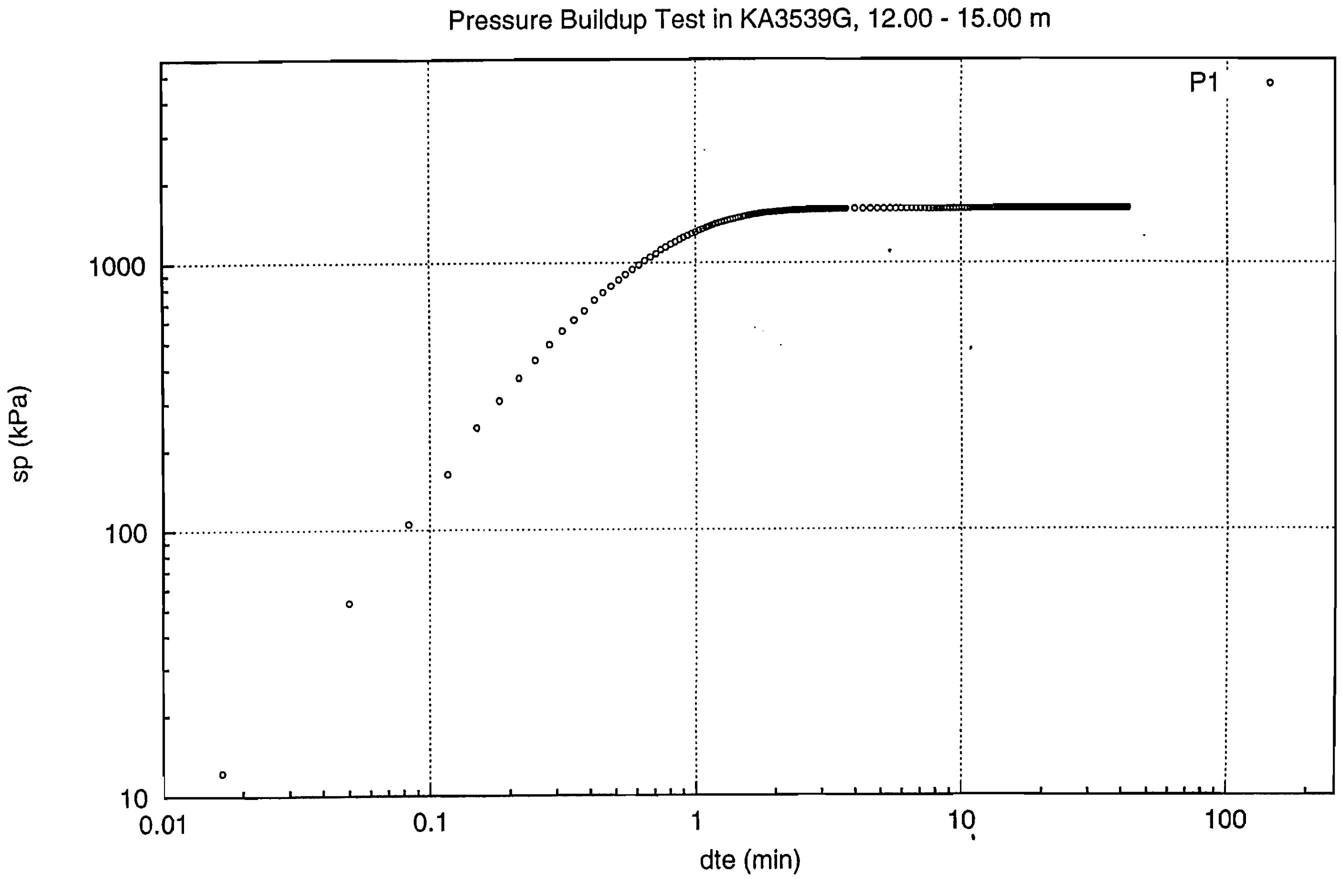
Interference test(recovery) in KA3539G(P1)
P1
sp (kPa)
dte (min)
KA3539G 0.39 - 30.01 m
Q_tot = 5.02 l/min
ds = 10.00 m
T_eval = - m²/s

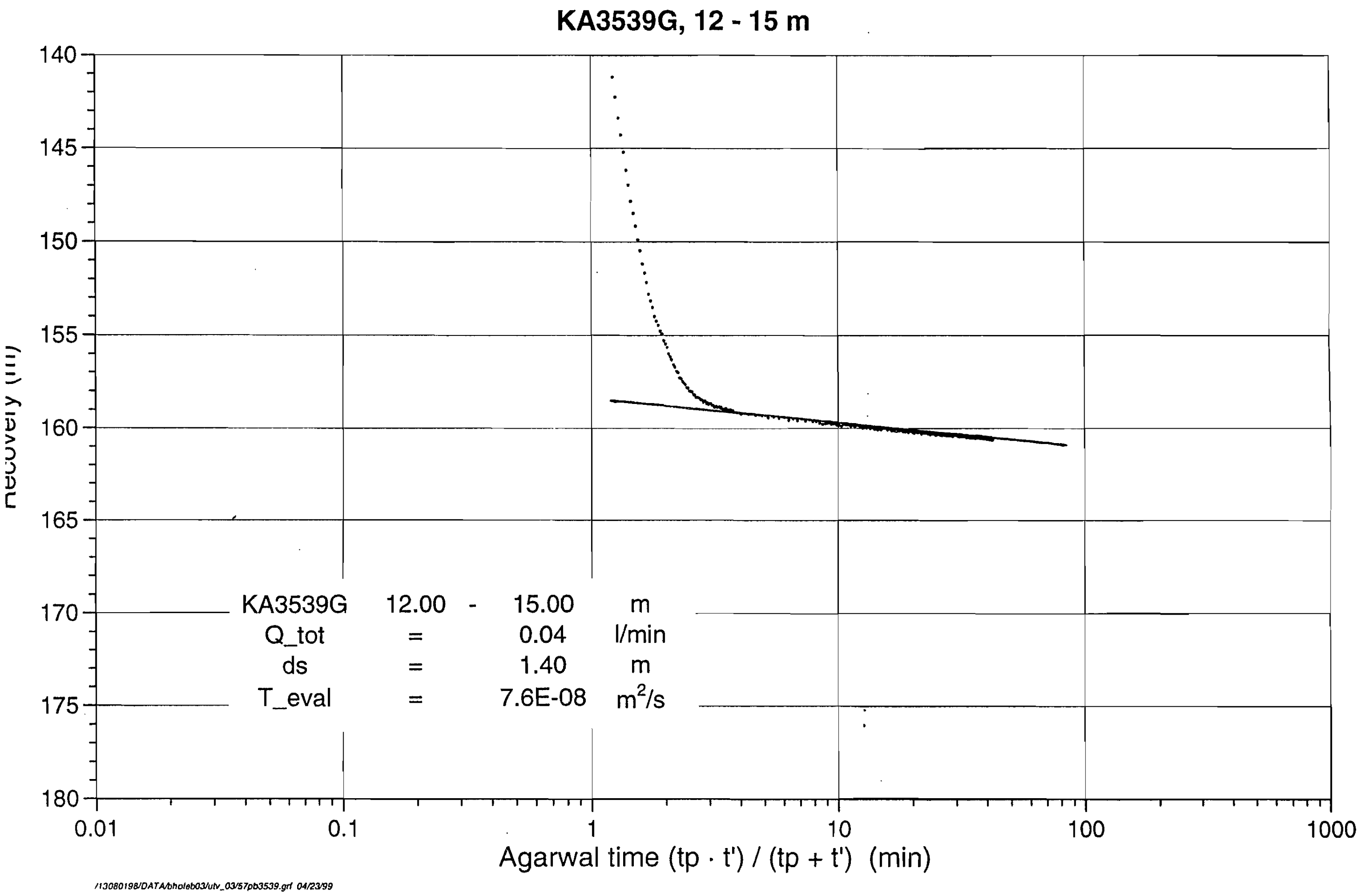


Pressure Buildup Test in KA3539G, 11.00 - 12.00 m
P1
sp (kPa)
10000
1000
100
0.01
0.1
1
10
100
dte (min)

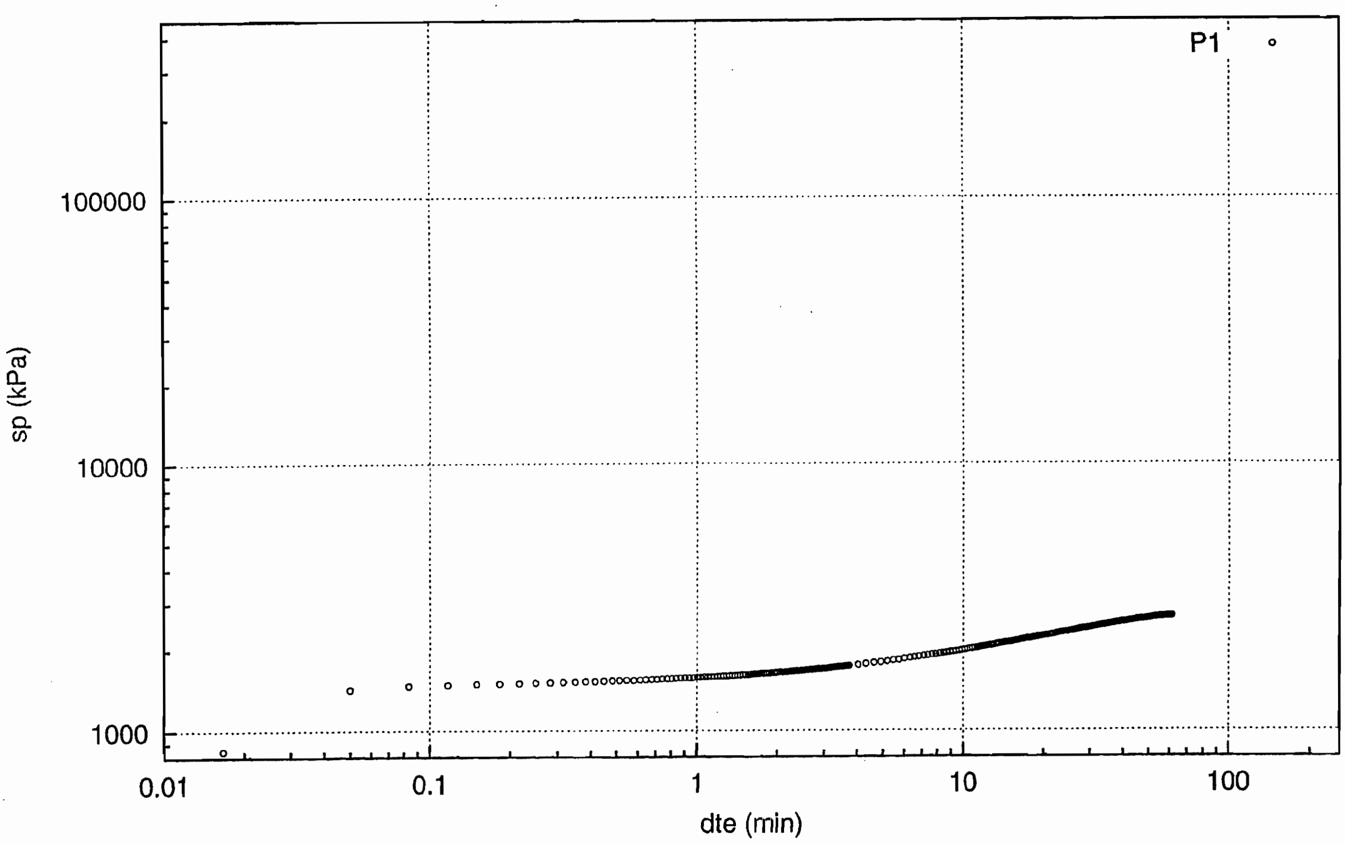


Pressure Buildup Test in KA3539G, 11.00 - 12.00 m
P1
sp (kPa)
0
500
1000
1500
2000
2500
KA3539G 11.00 - 12.00 m
Q_tot = 0.09 l/min
ds = 26.97 m
T_eval = 4.5E-08 m2/s
0.01
0.1
1
10
100
dte (min)

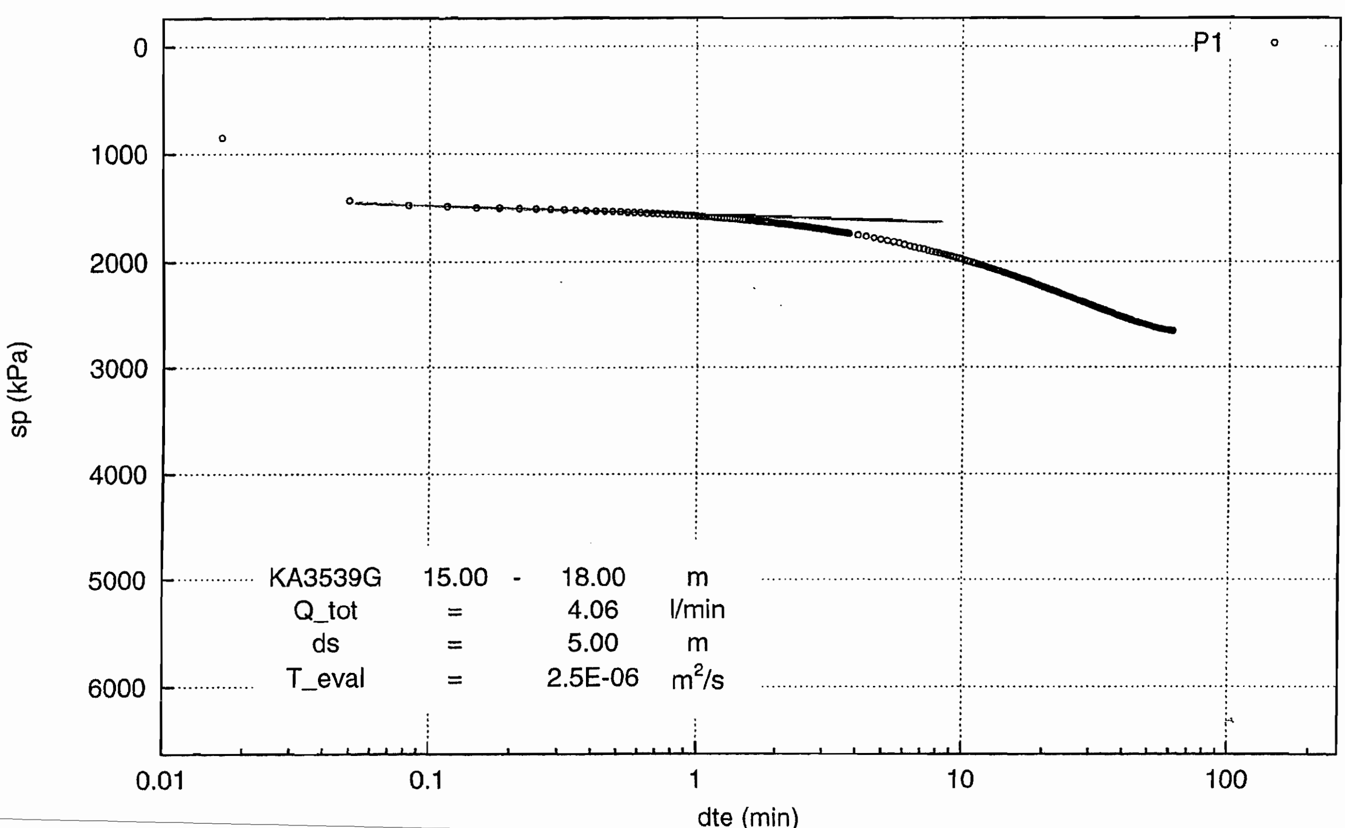

Pressure Buildup Test in KA3539G, 12.00 - 15.00 m
P1
sp (kPa)
dte (min)
10
100
1000
0.01
0.1
1
10
100

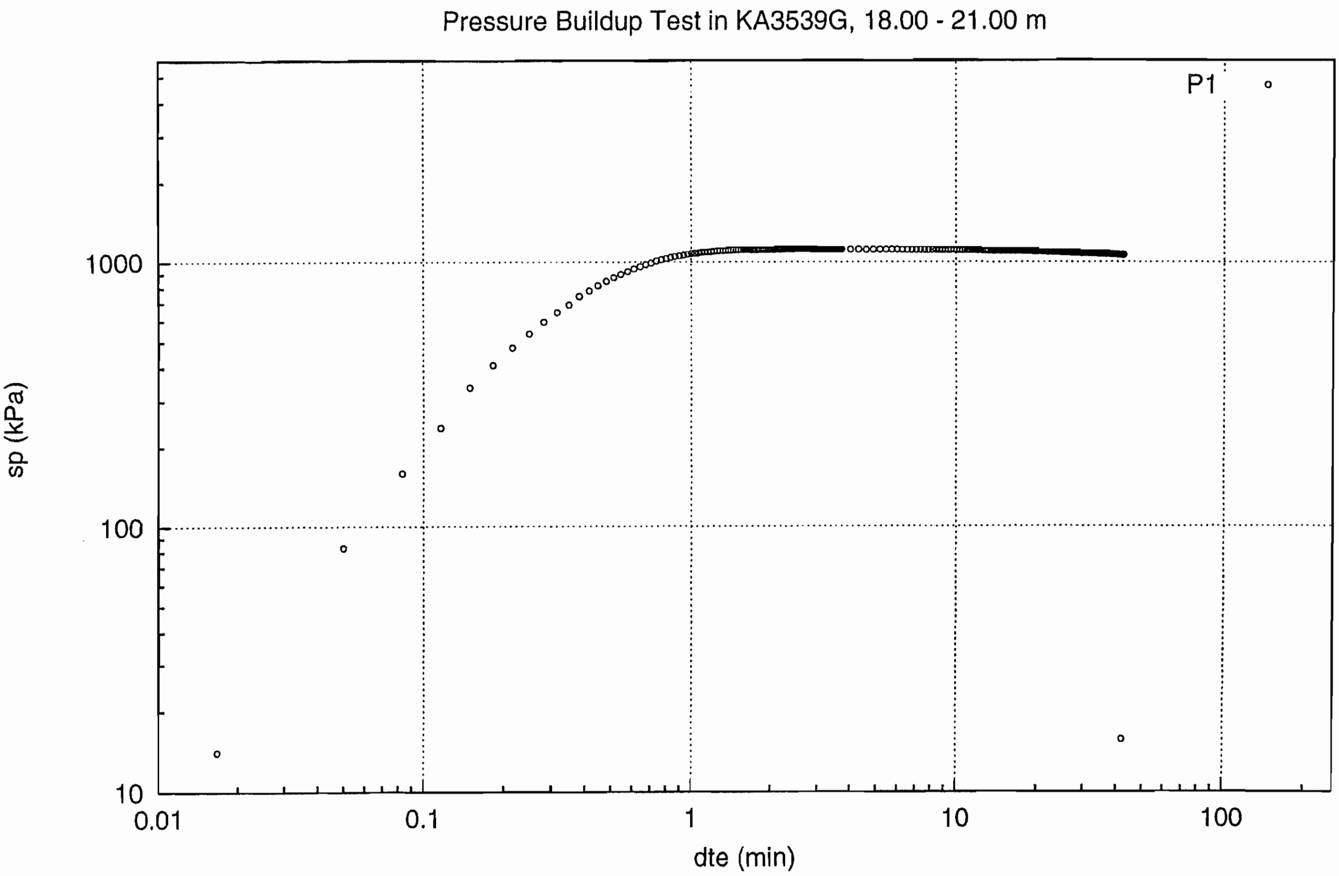

KA3539G, 12 - 15 m
Recovery (m)
Agarwal time (tp · t') / (tp + t') (min)
KA3539G 12.00 - 15.00 m
Q_tot = 0.04 l/min
ds = 1.40 m
T_eval = 7.6E-08 m2/s
140
145
150
155
160
165
170
175
180
0.01
0.1
1
10
100
1000
/13080198/DATA/bholeb03/utv_03/57pb3539.grf 04/23/99

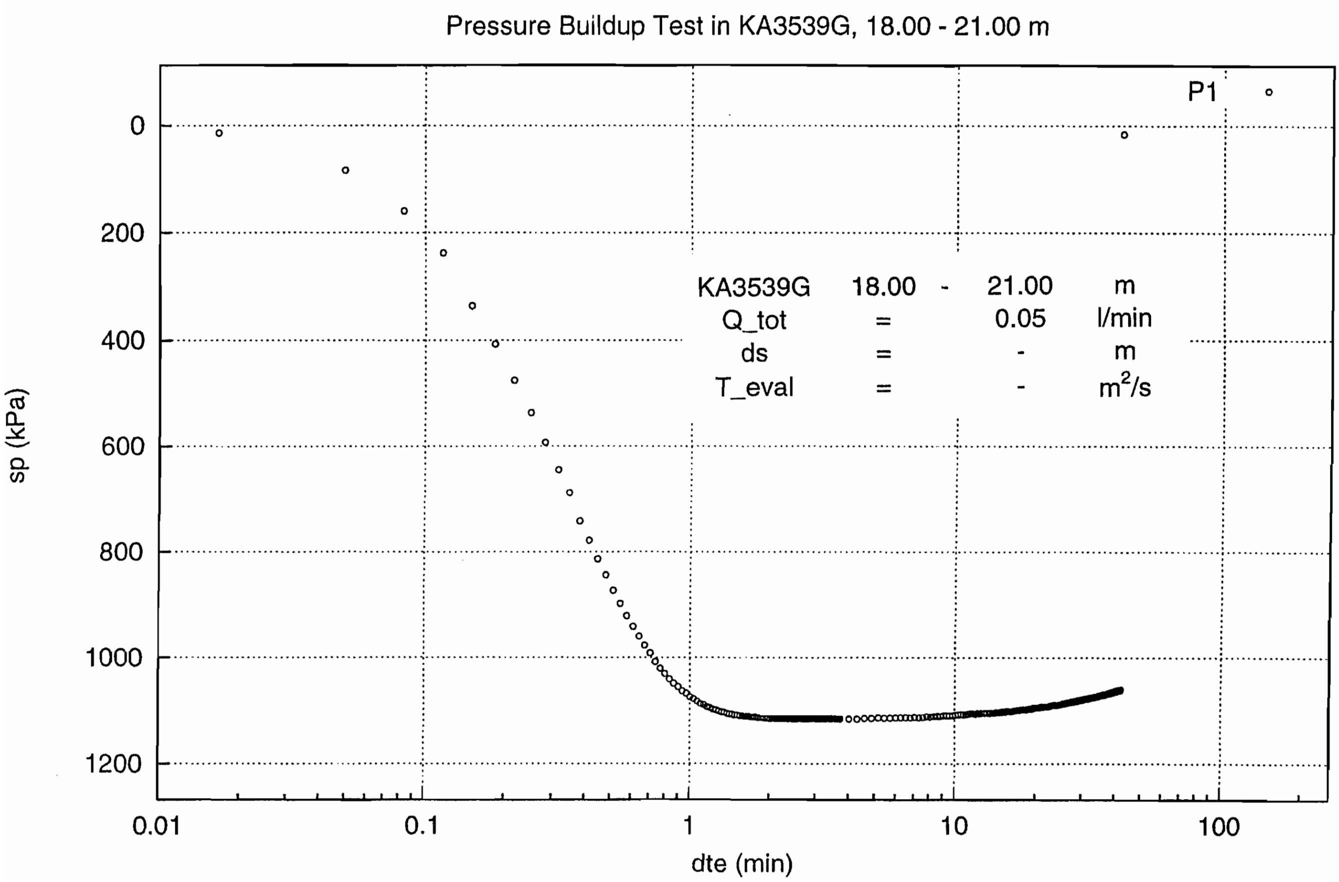
Pressure Buildup Test in KA3539G, 15.00 - 18.00 m



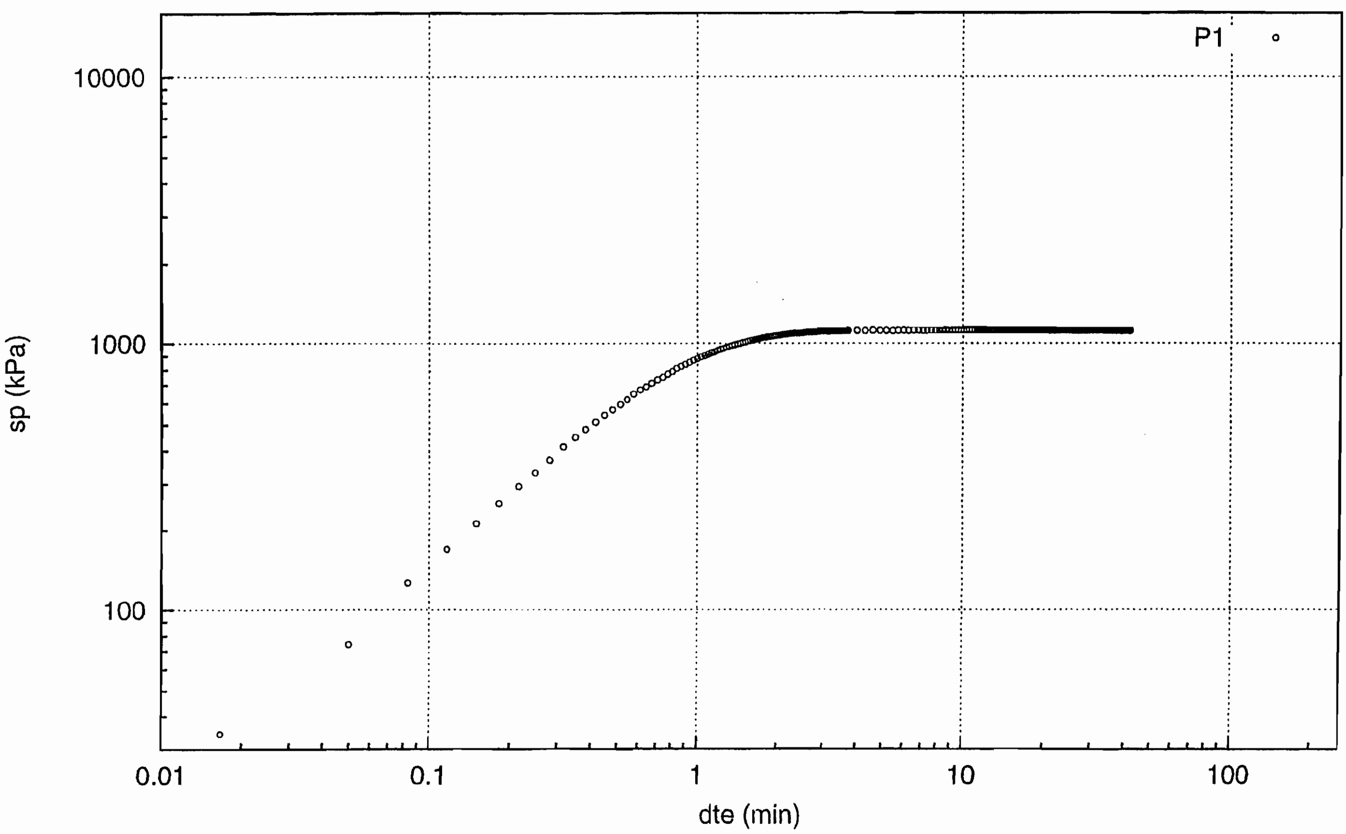
Pressure Buildup Test in KA3539G, 15.00 - 18.00 m



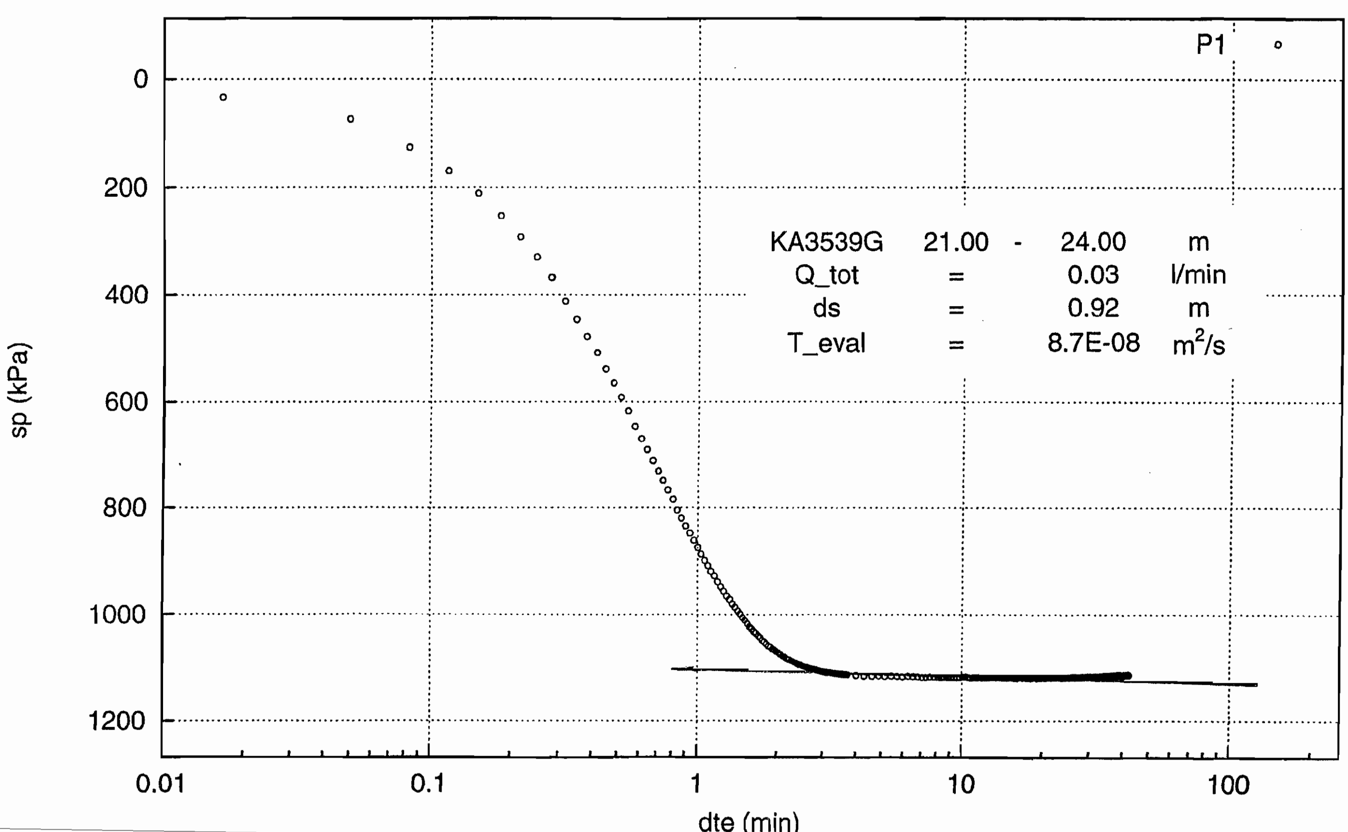

Pressure Buildup Test in KA3539G, 18.00 - 21.00 m
P1
1000
100
10
0.01
0.1
1
10
100
sp (kPa)
dte (min)

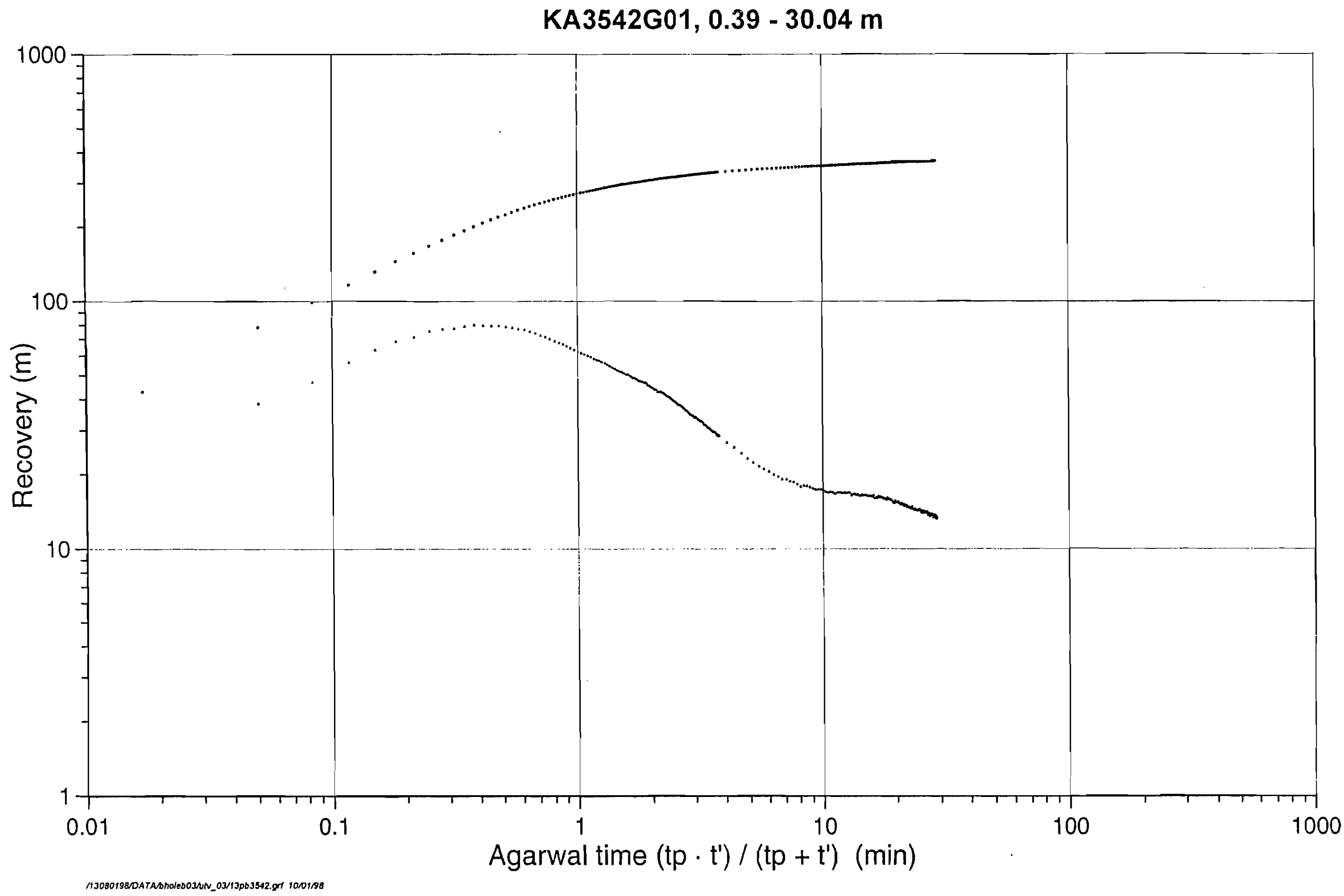

Pressure Buildup Test in KA3539G, 18.00 - 21.00 m
P1
KA3539G 18.00 - 21.00 m
Q_tot = 0.05 l/min
ds = - m
T_eval = - m2/s
0
200
400
600
800
1000
1200
0.01
0.1
1
10
100
sp (kPa)
dte (min)

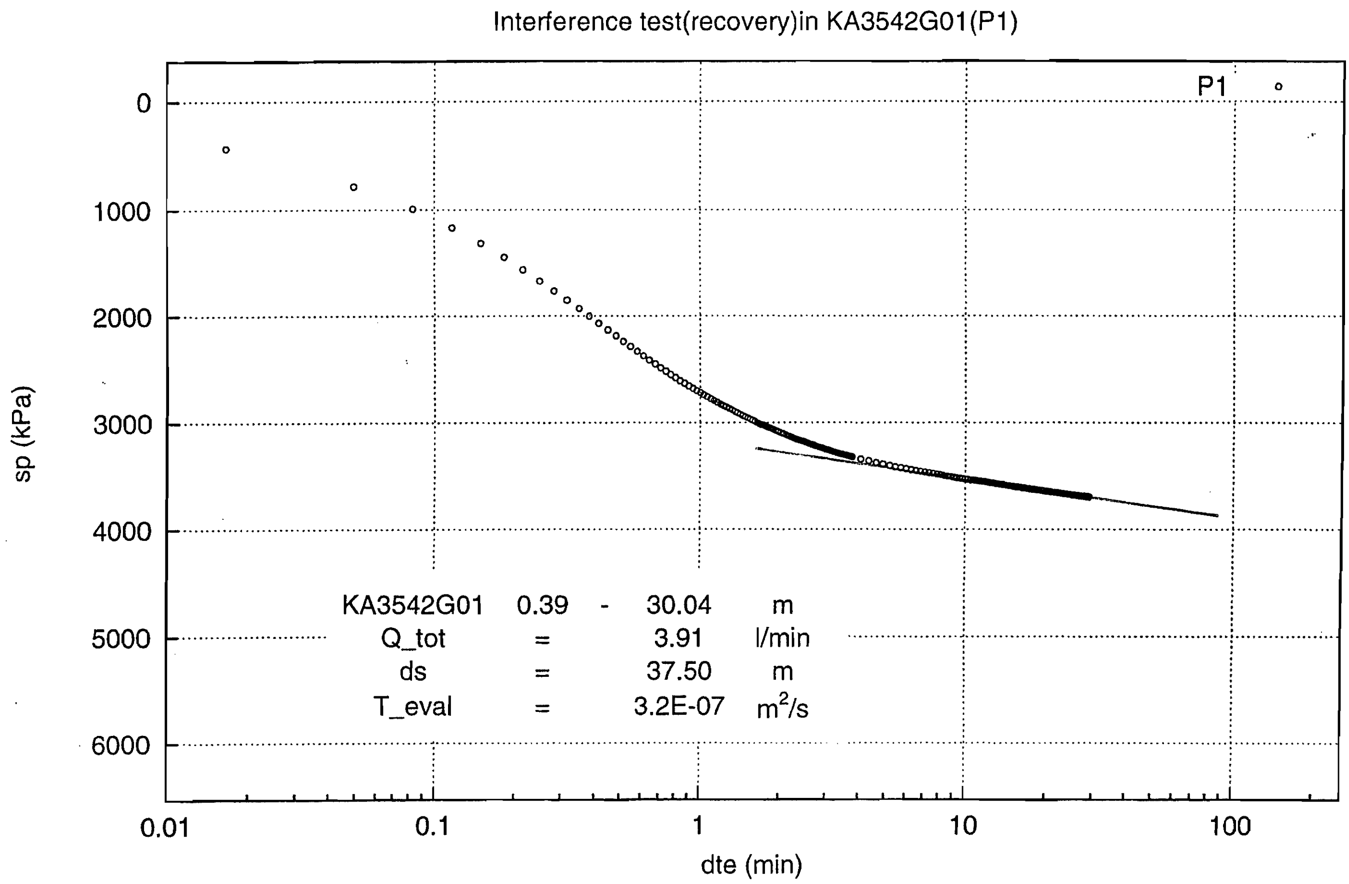
Pressure Buildup Test in KA3539G, 21.00 - 24.00 m



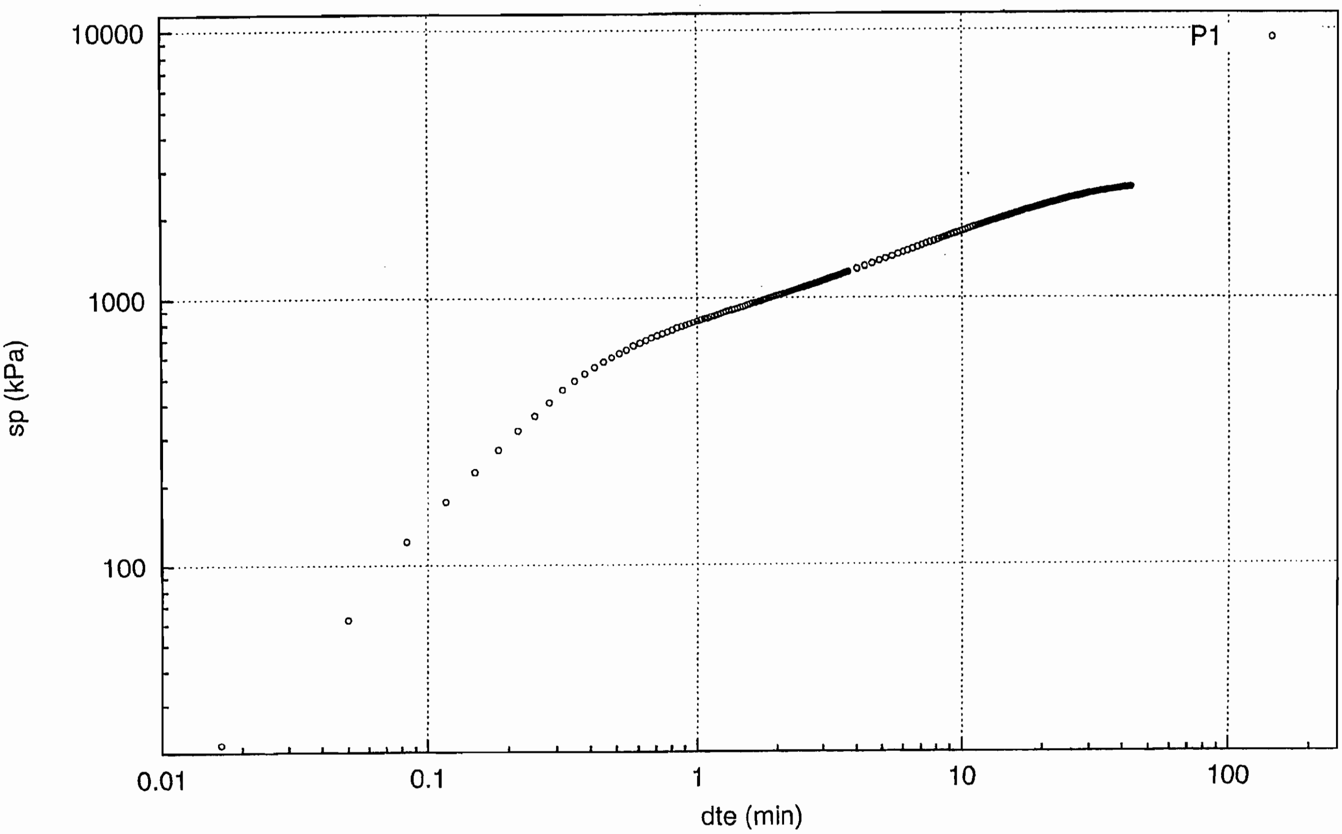
Pressure Buildup Test in KA3539G, 21.00 - 24.00 m



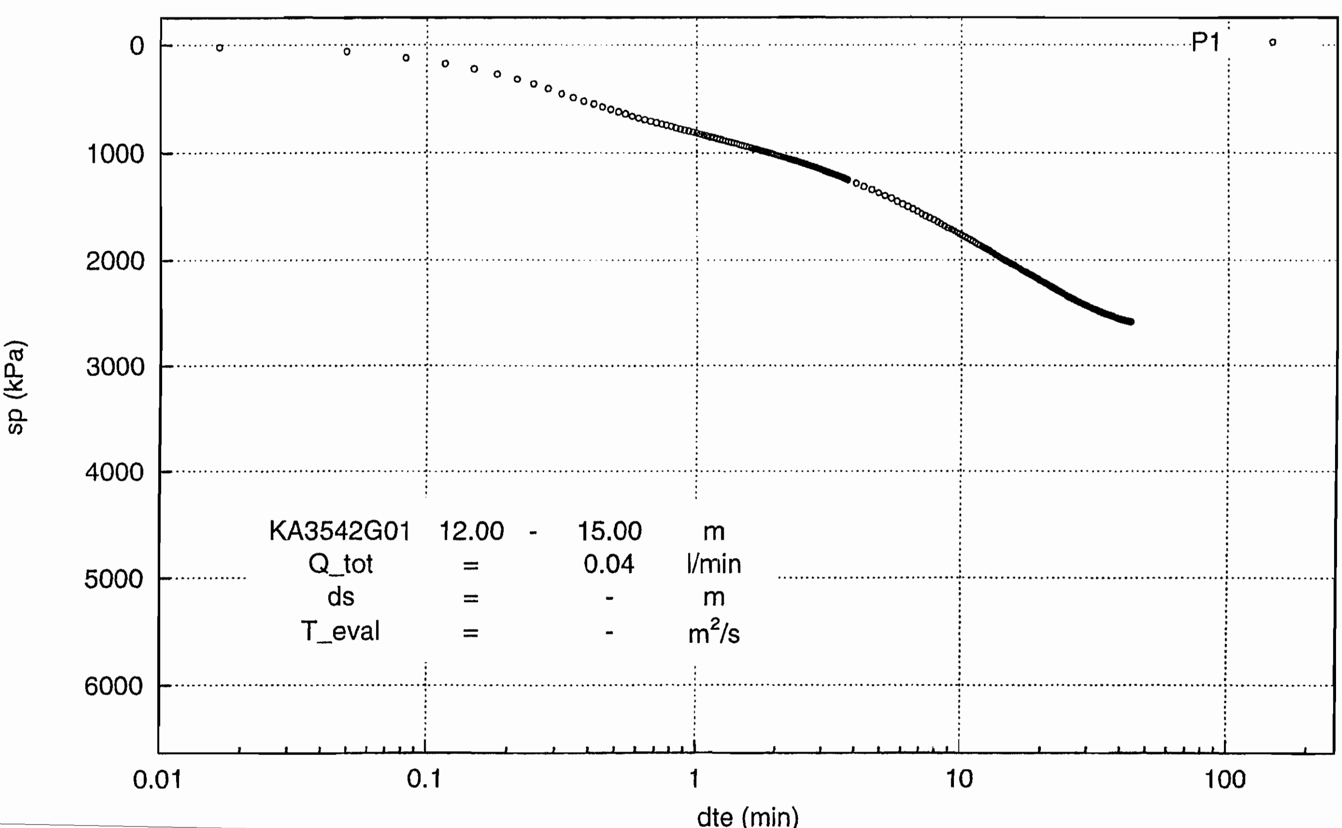

KA3542G01, 0.39 - 30.04 m
1000
100
10
1
Recovery (m)
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/13pb3542.grf 10/01/98

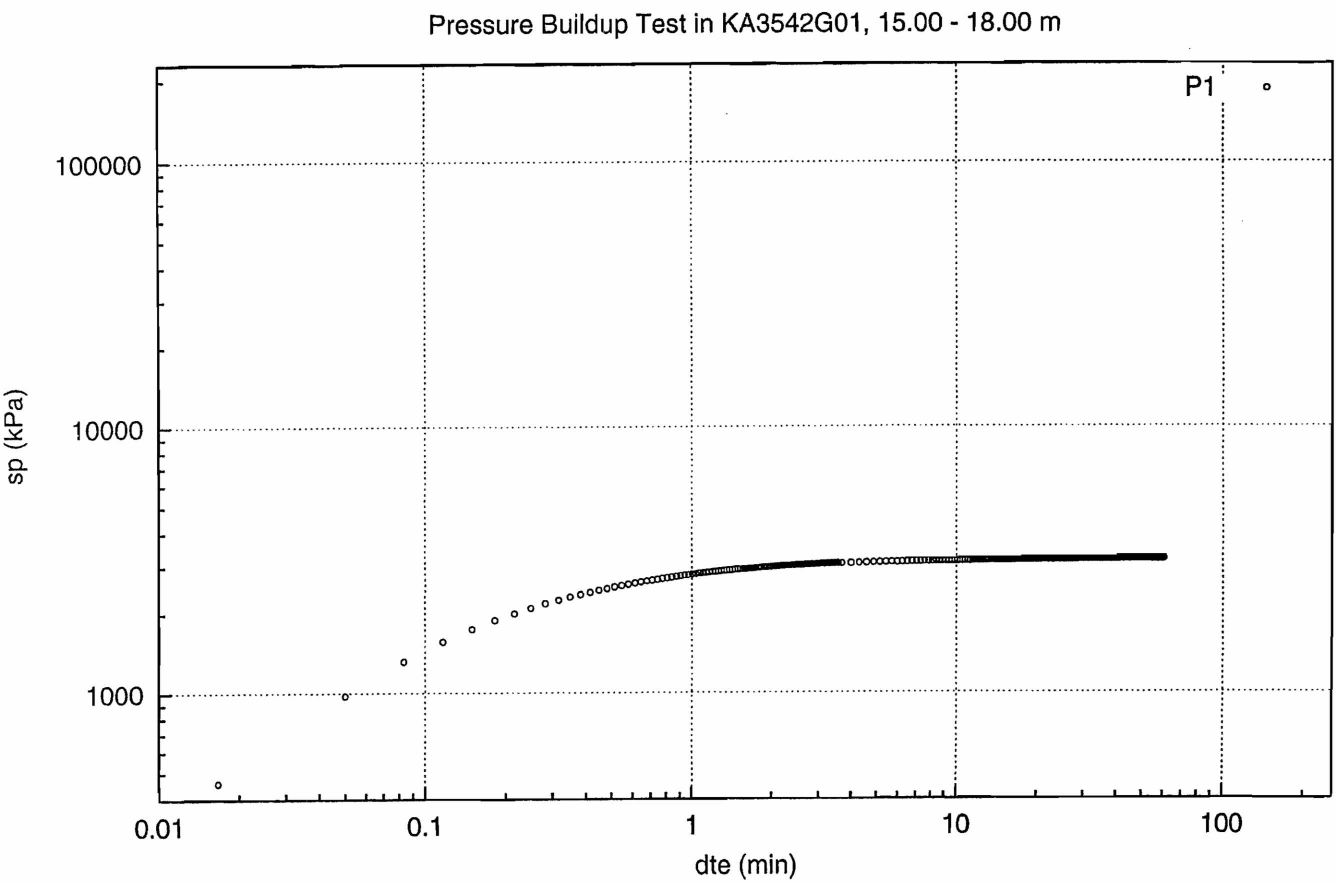

Interference test(recovery)in KA3542G01(P1)
P1
0
1000
2000
3000
4000
5000
6000
sp (kPa)
KA3542G01 0.39 - 30.04 m
Q_tot = 3.91 l/min
ds = 37.50 m
T_eval = 3.2E-07 m2/s
0.01
0.1
1
10
100
dte (min)

Pressure Buildup Test in KA3542G01, 12.00 - 15.00 m

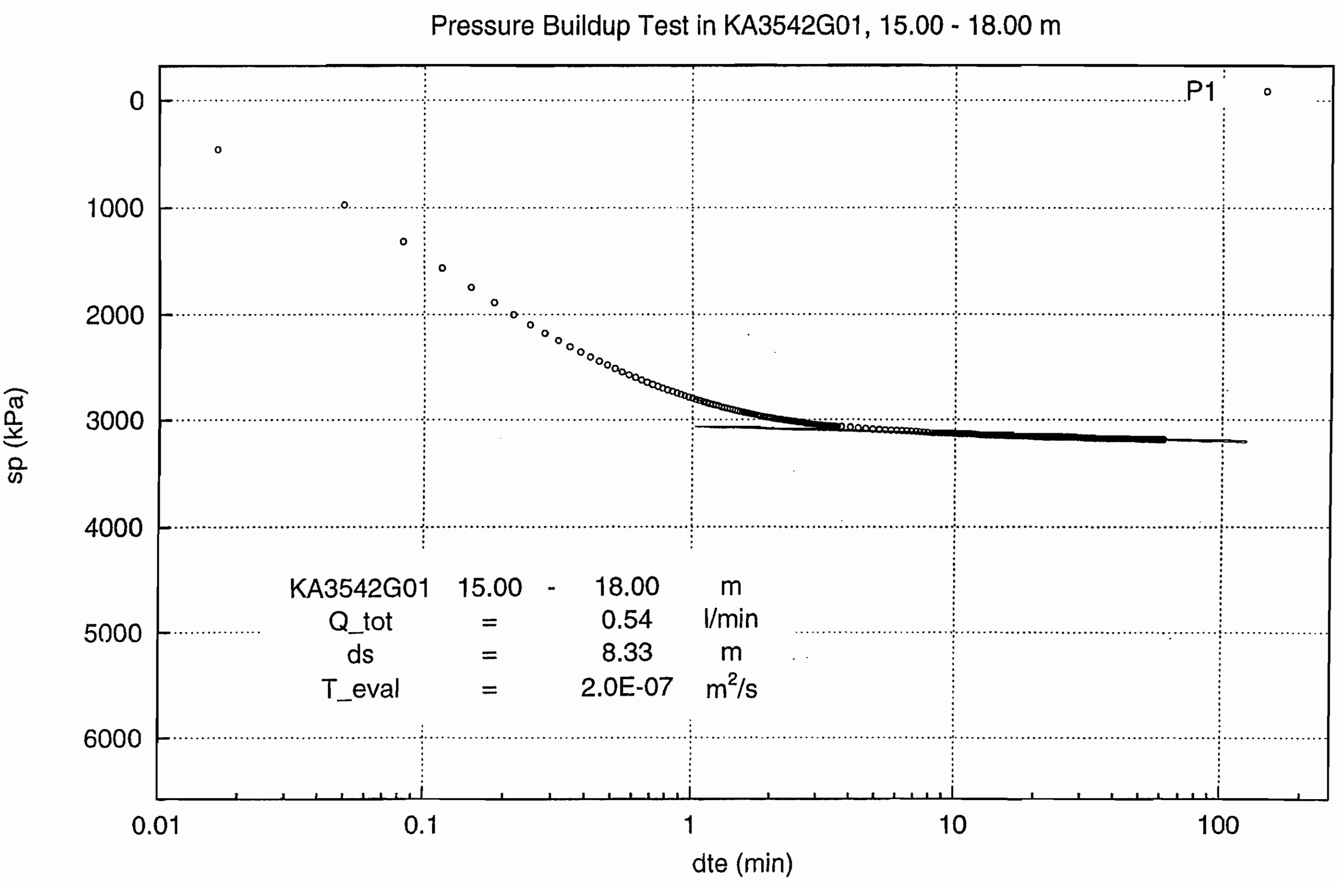


Pressure Buildup Test in KA3542G01, 12.00 - 15.00 m

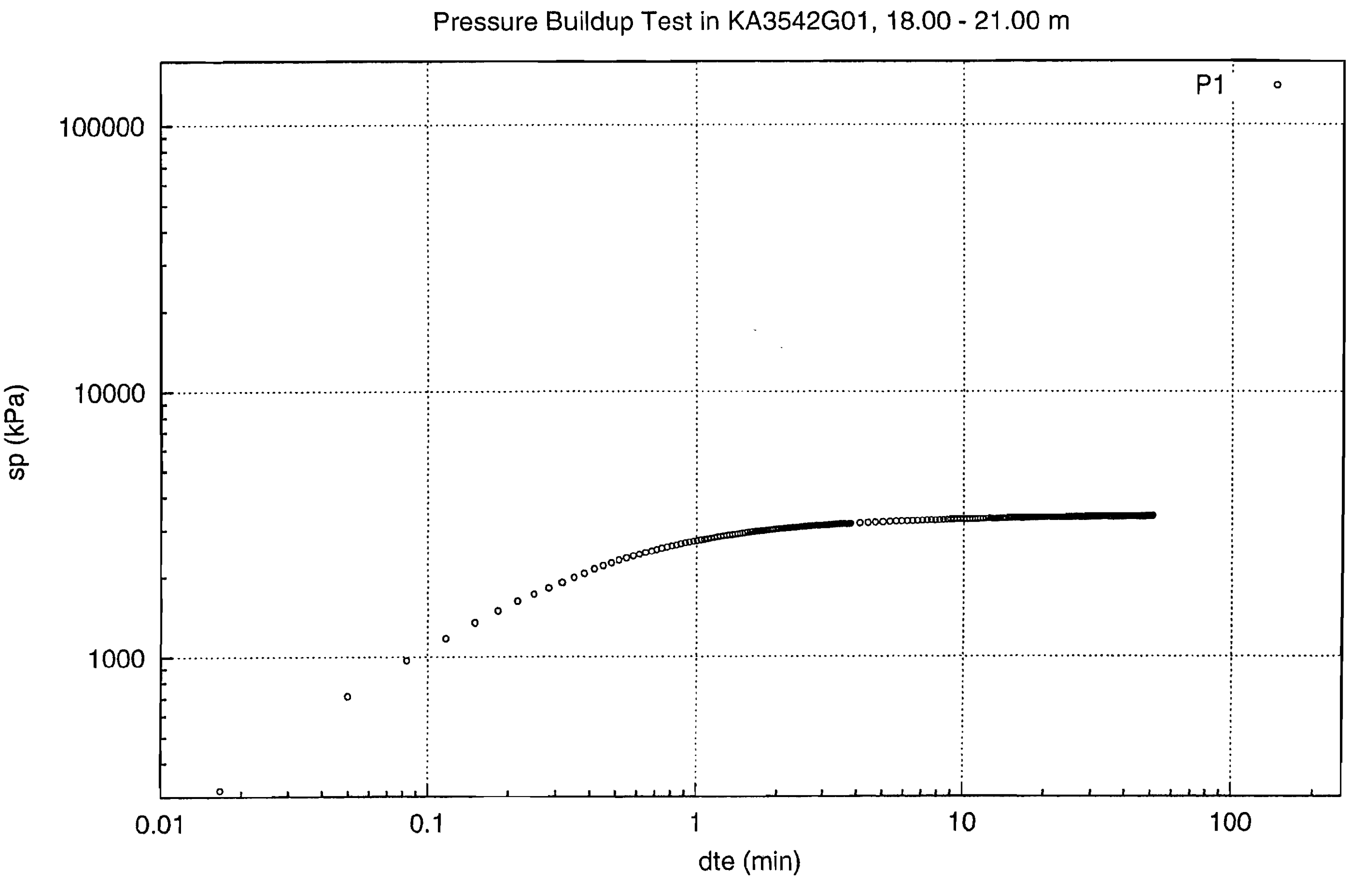


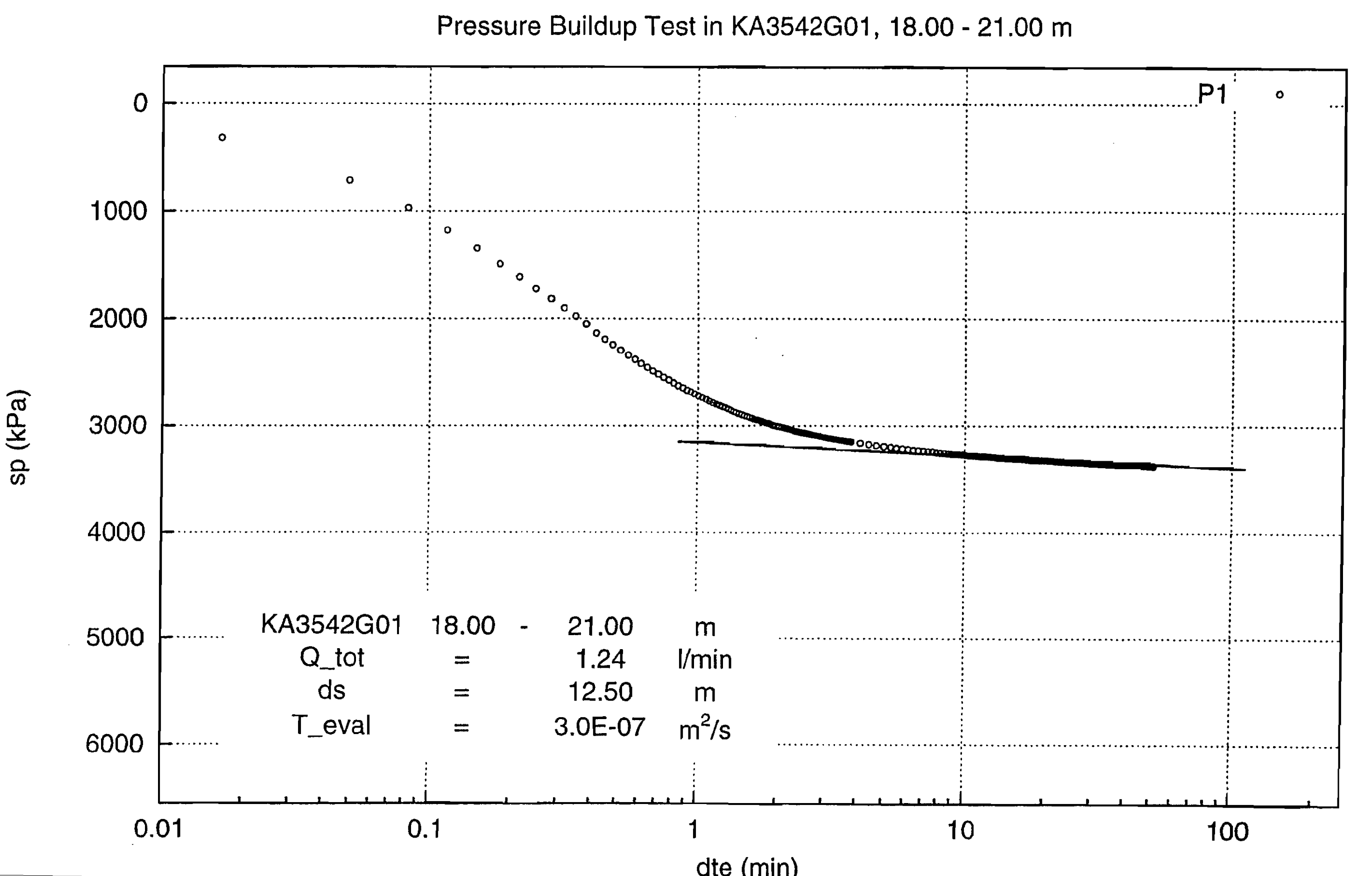


Pressure Buildup Test in KA3542G01, 15.00 - 18.00 m
P1
100000
10000
1000
sp (kPa)
0.01
0.1
1
10
100
dte (min)

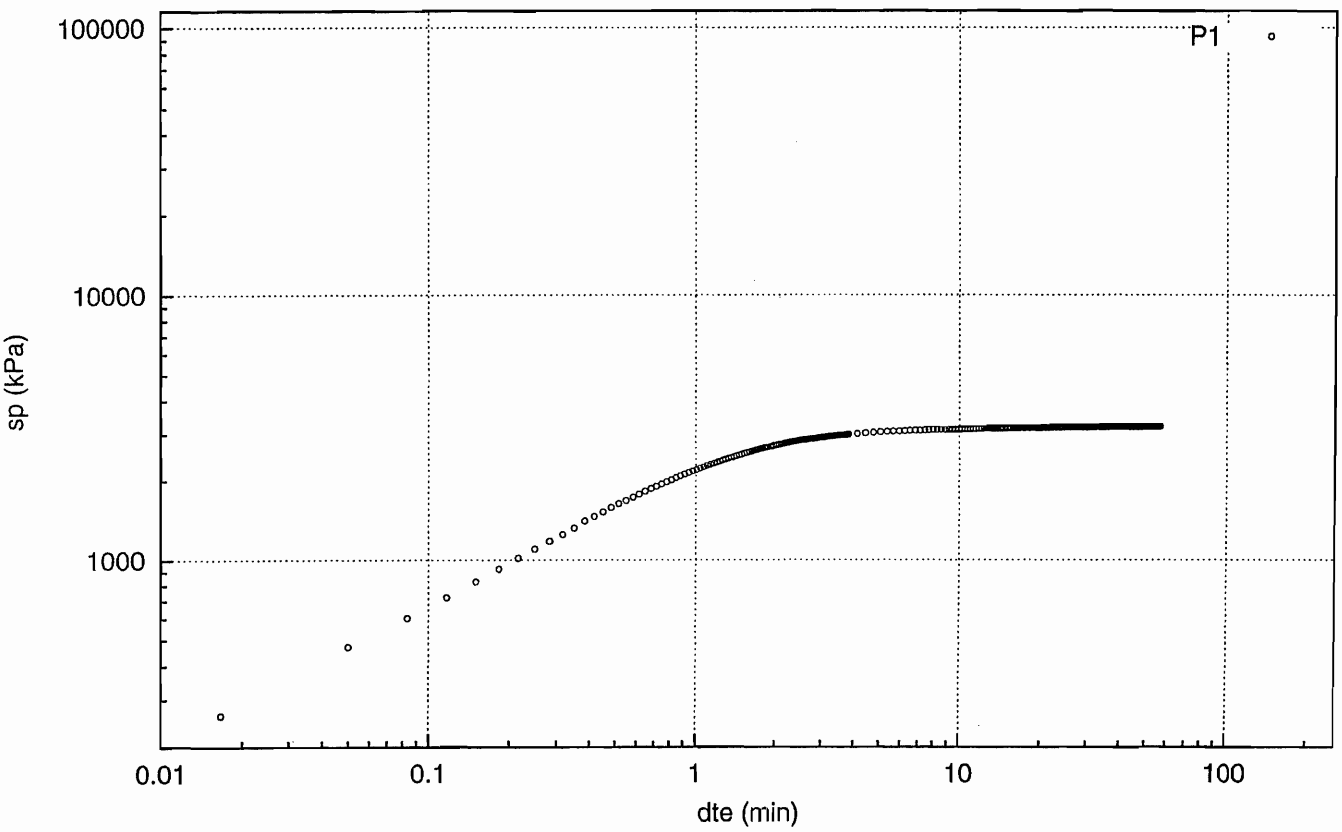


Pressure Buildup Test in KA3542G01, 15.00 - 18.00 m
P1
0
1000
2000
3000
4000
5000
6000
sp (kPa)
KA3542G01 15.00 - 18.00 m
Q_tot = 0.54 l/min
ds = 8.33 m
T_eval = 2.0E-07 m²/s
0.01
0.1
1
10
100
dte (min)

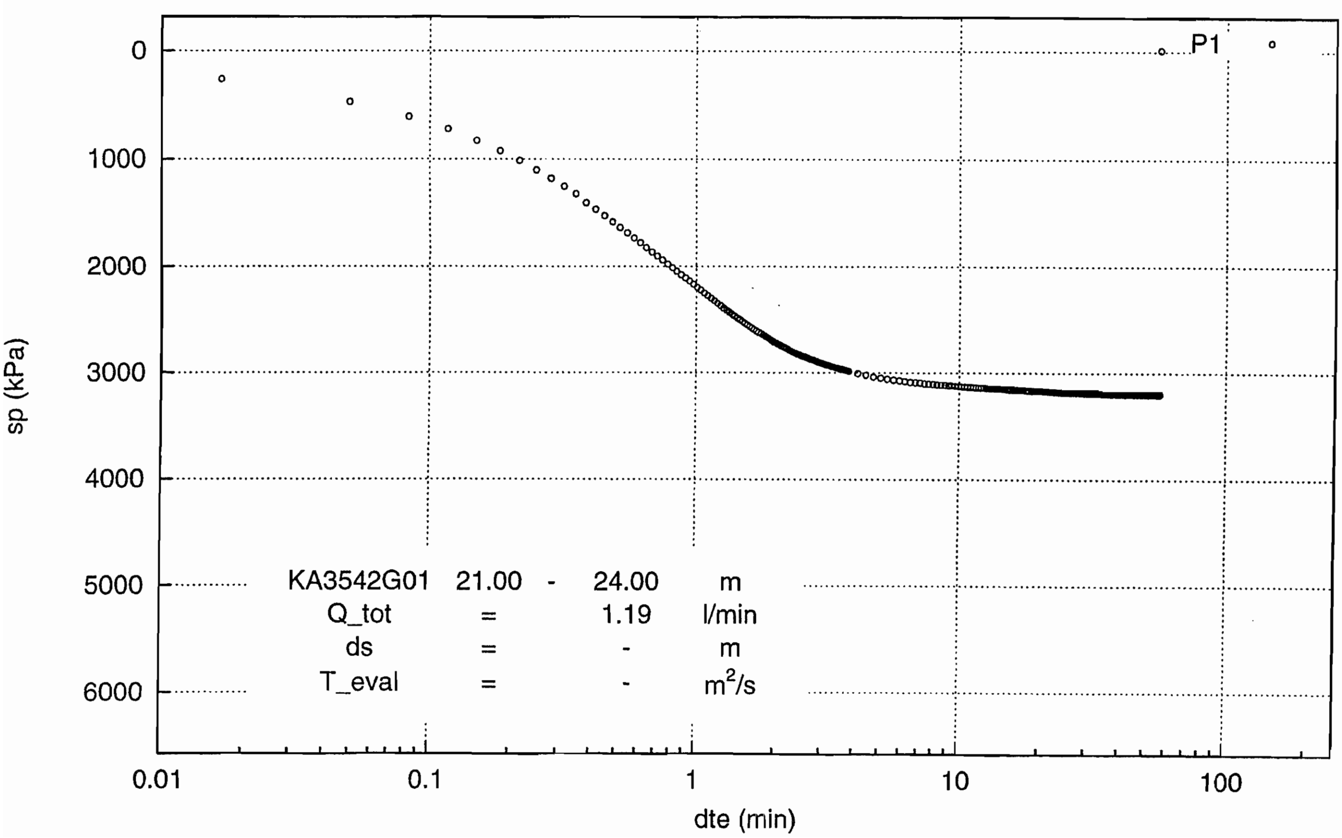

Pressure Buildup Test in KA3542G01, 18.00 - 21.00 m
P1
100000
10000
1000
sp (kPa)
0.01
0.1
1
10
100
dte (min)


Pressure Buildup Test in KA3542G01, 18.00 - 21.00 m
P1
0
1000
2000
3000
4000
5000
6000
sp (kPa)
KA3542G01 18.00 - 21.00 m
Q_tot = 1.24 l/min
ds = 12.50 m
T_eval = 3.0E-07 m²/s
0.01
0.1
1
10
100
dte (min)

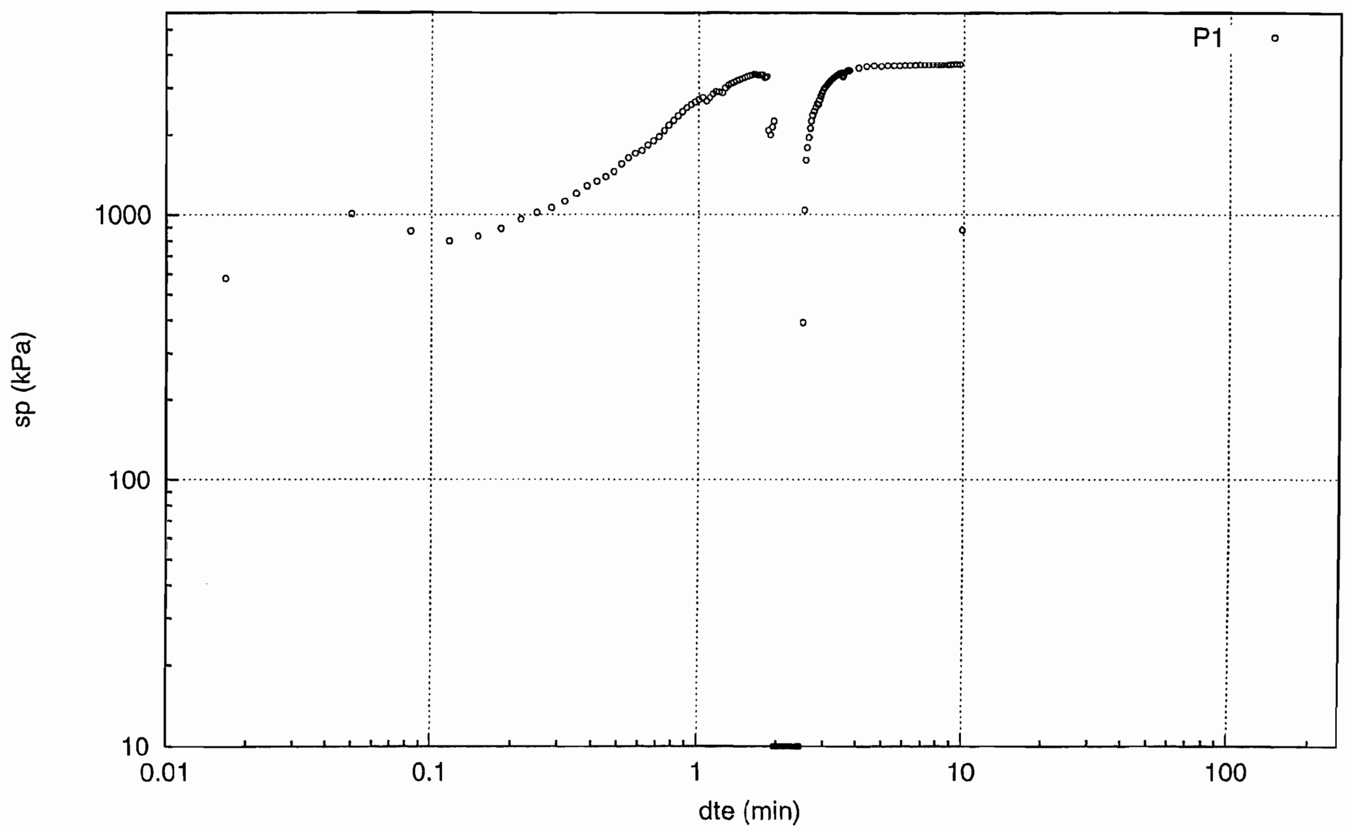
Pressure Buildup Test in KA3542G01, 21.00 - 24.00 m



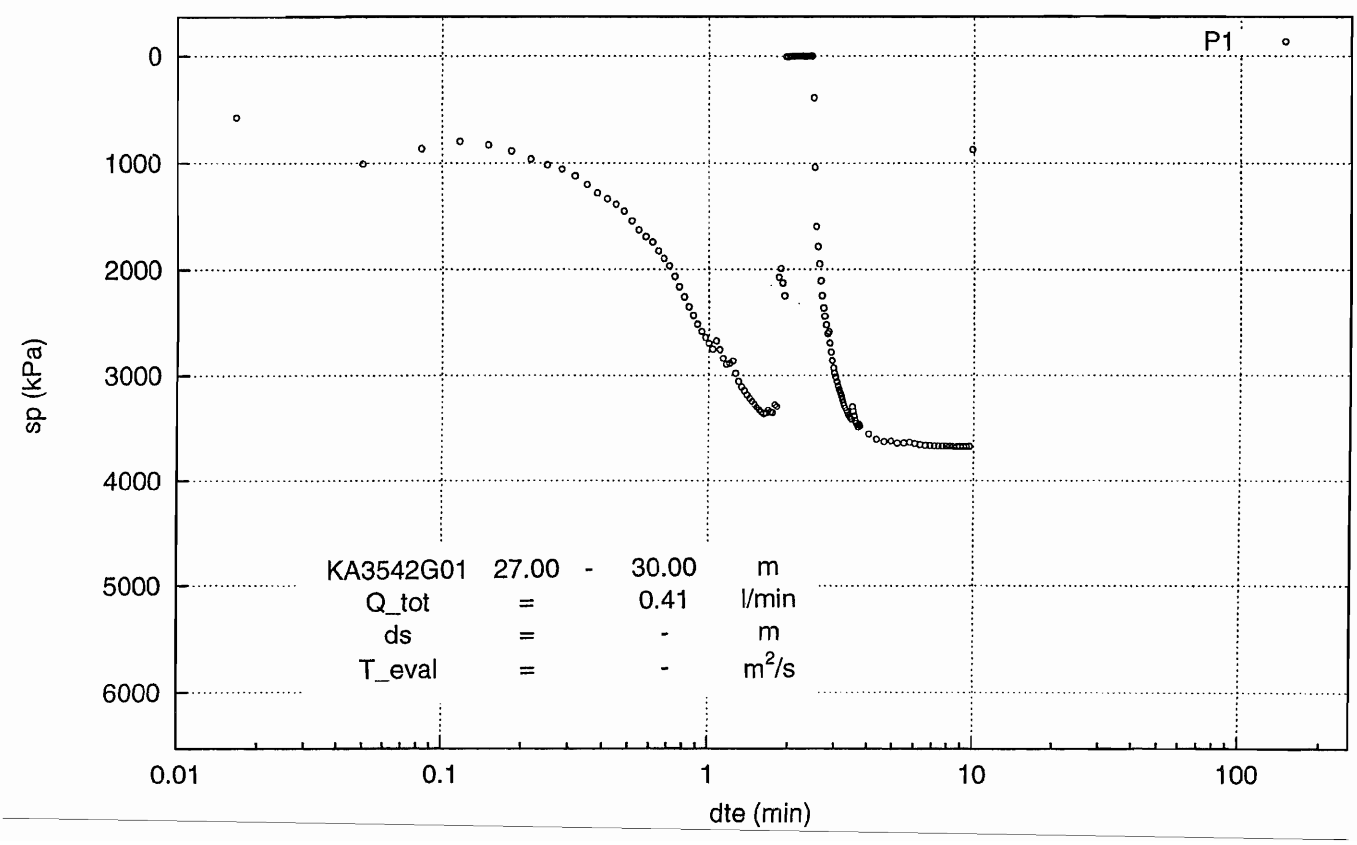
Pressure Buildup Test in KA3542G01, 21.00 - 24.00 m

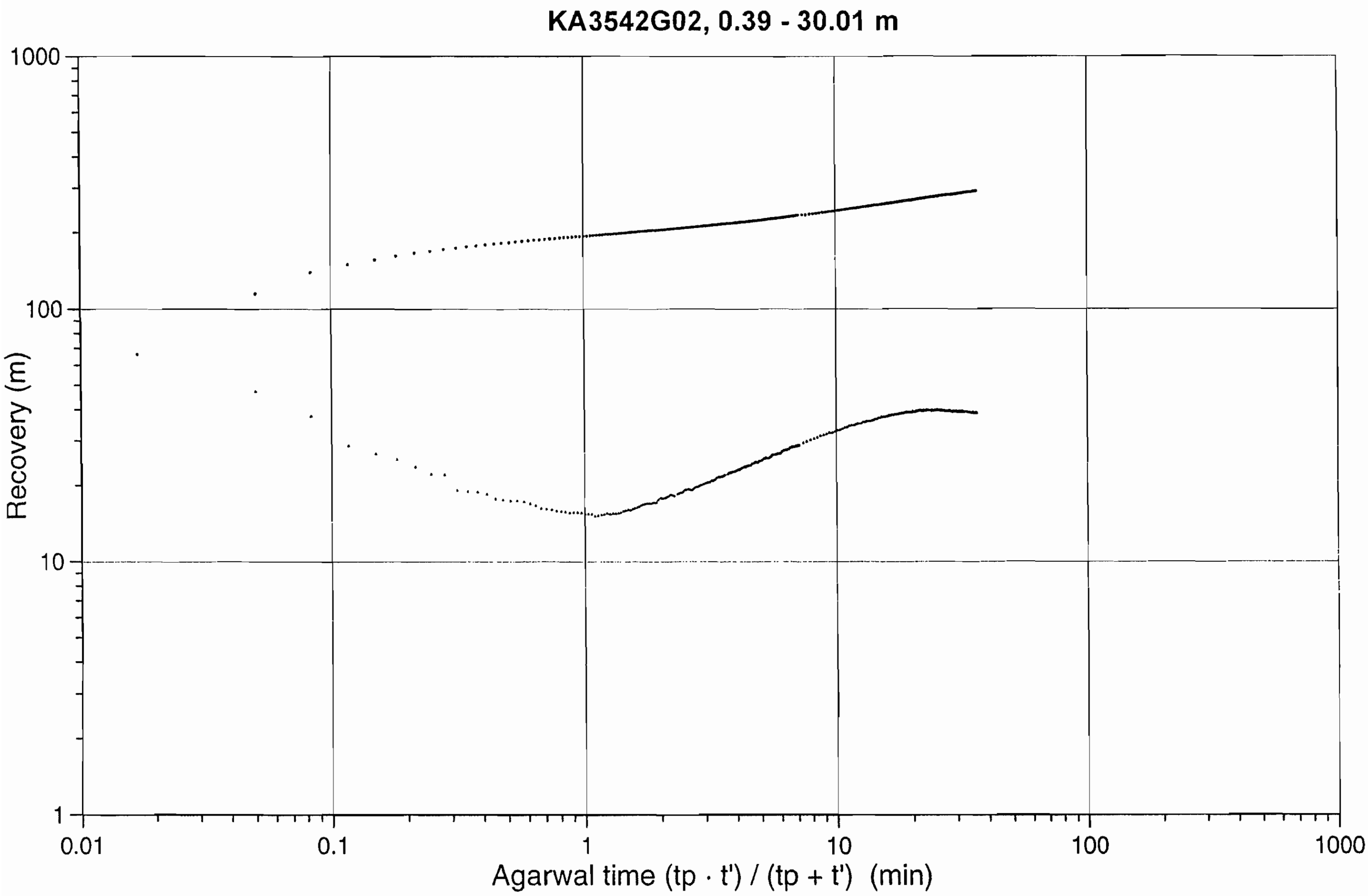


Pressure Buildup Test in KA3542G01, 27.00 - 30.00 m

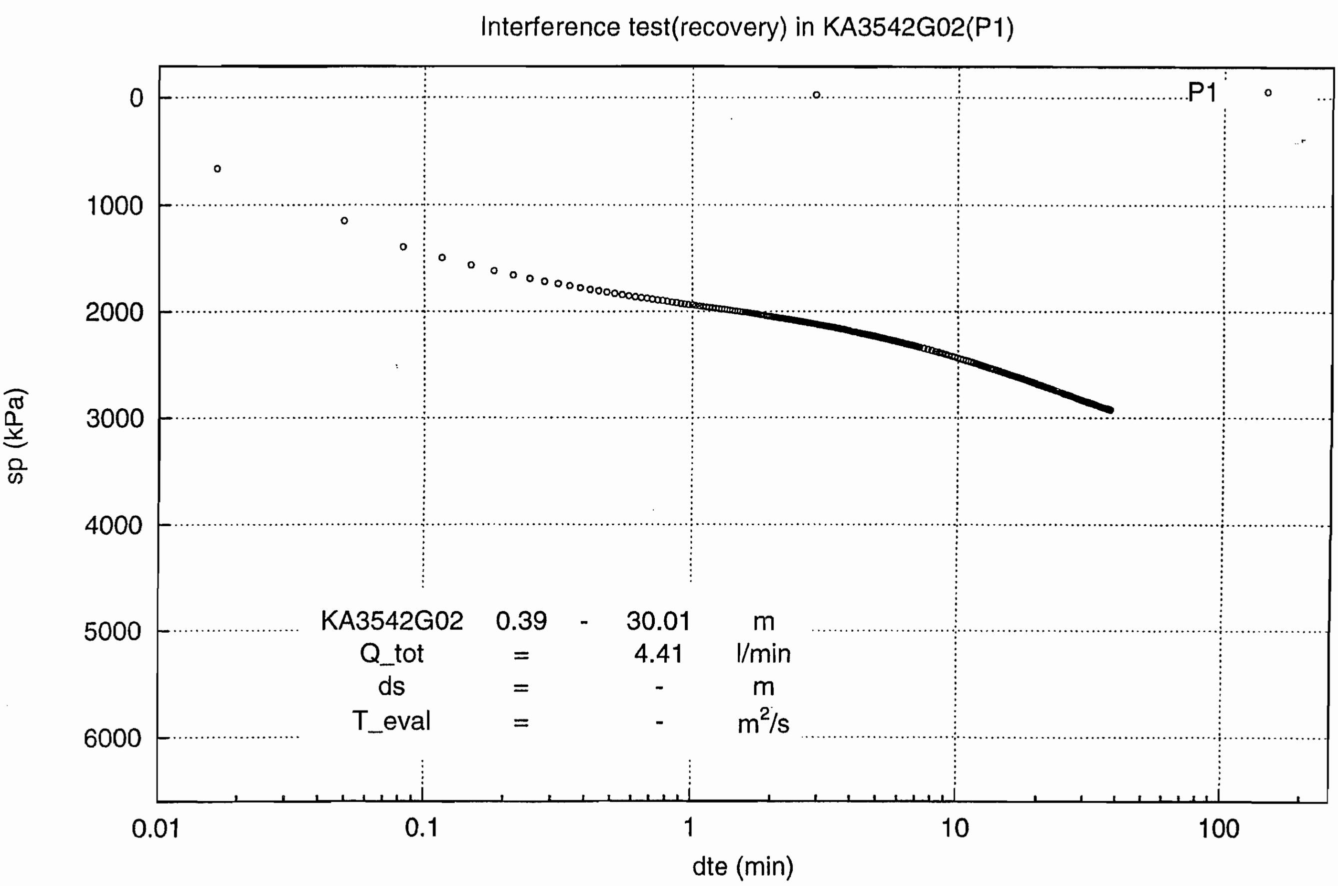


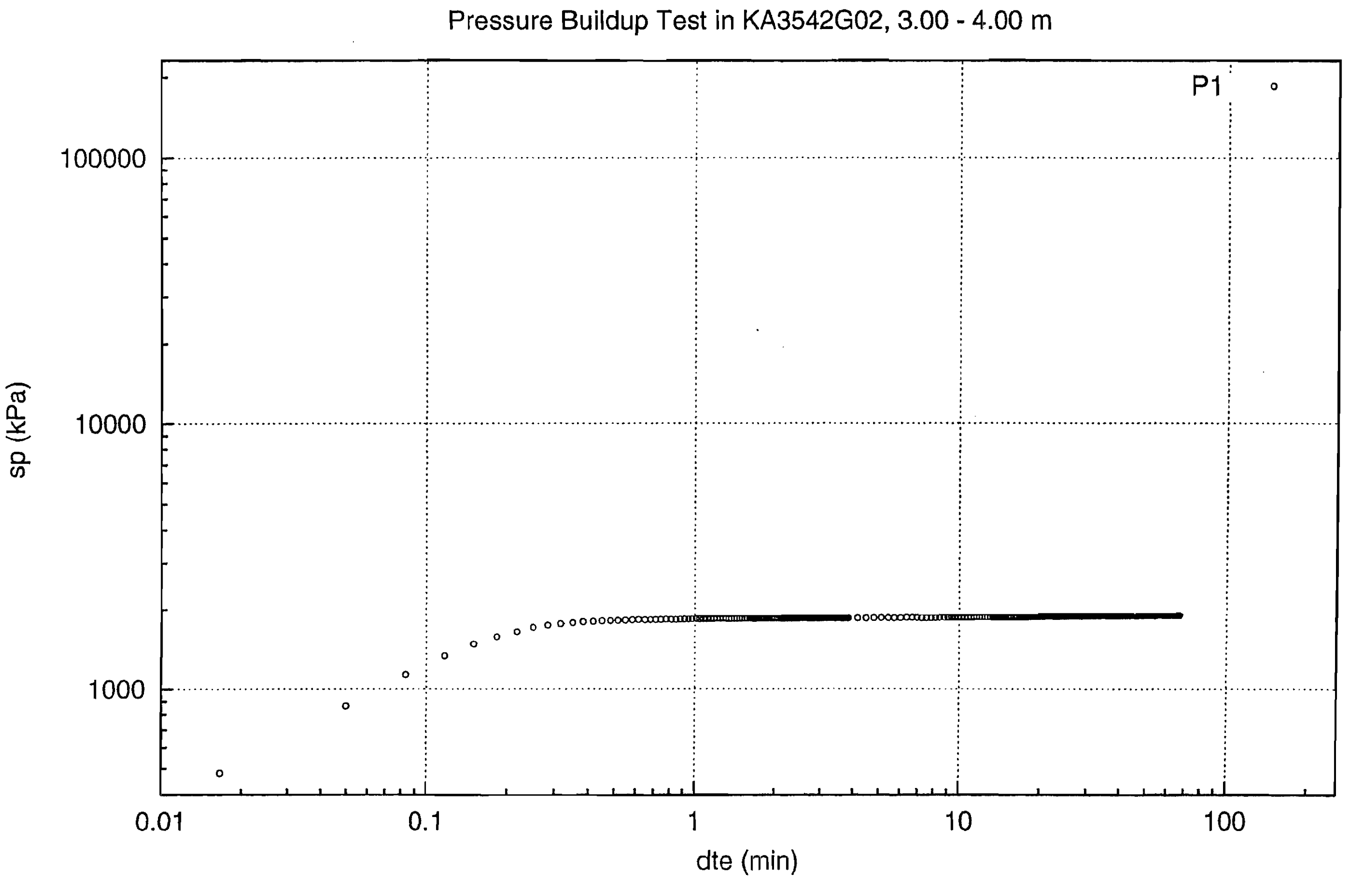
Pressure Buildup Test in KA3542G01, 27.00 - 30.00 m

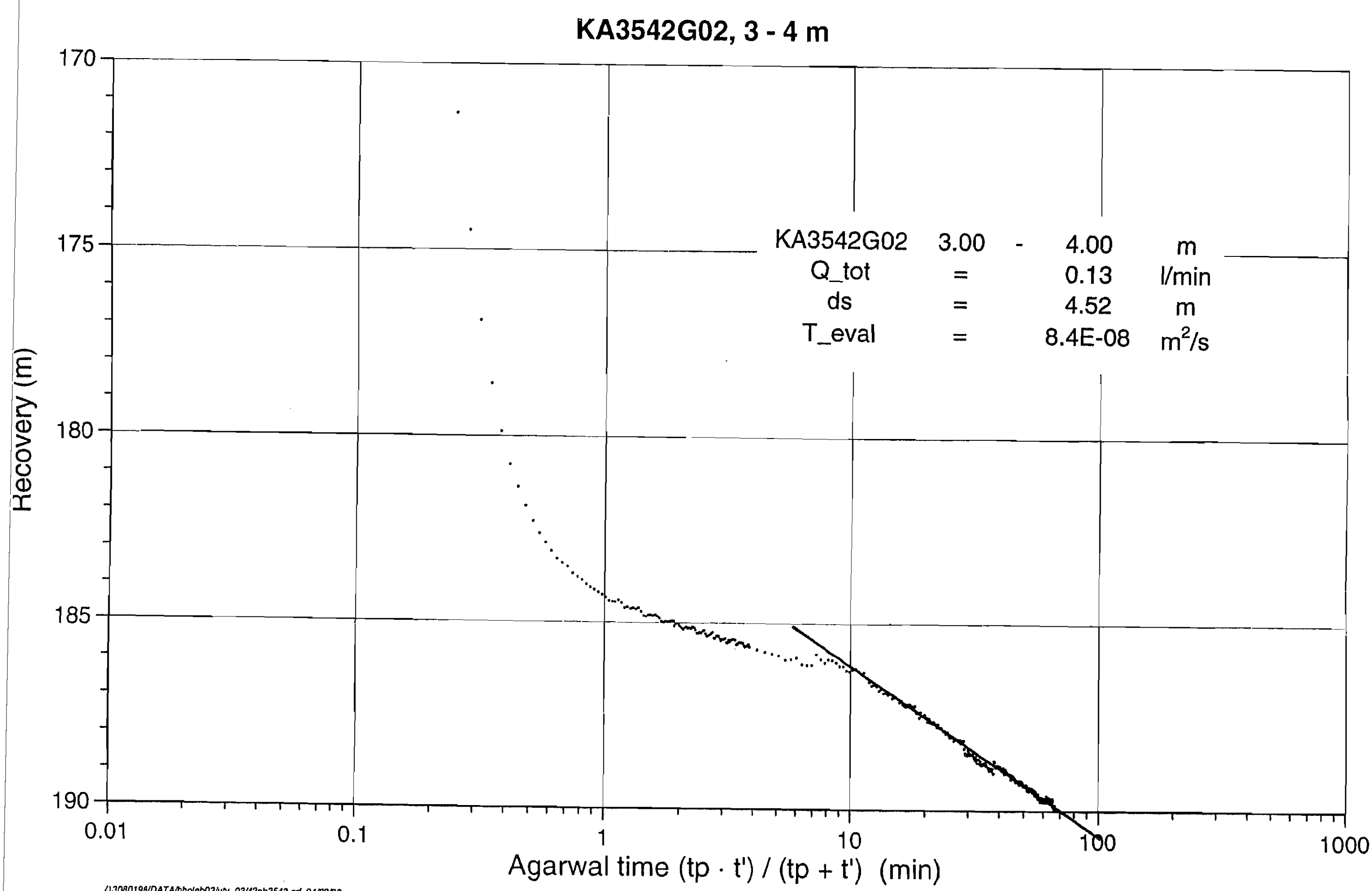




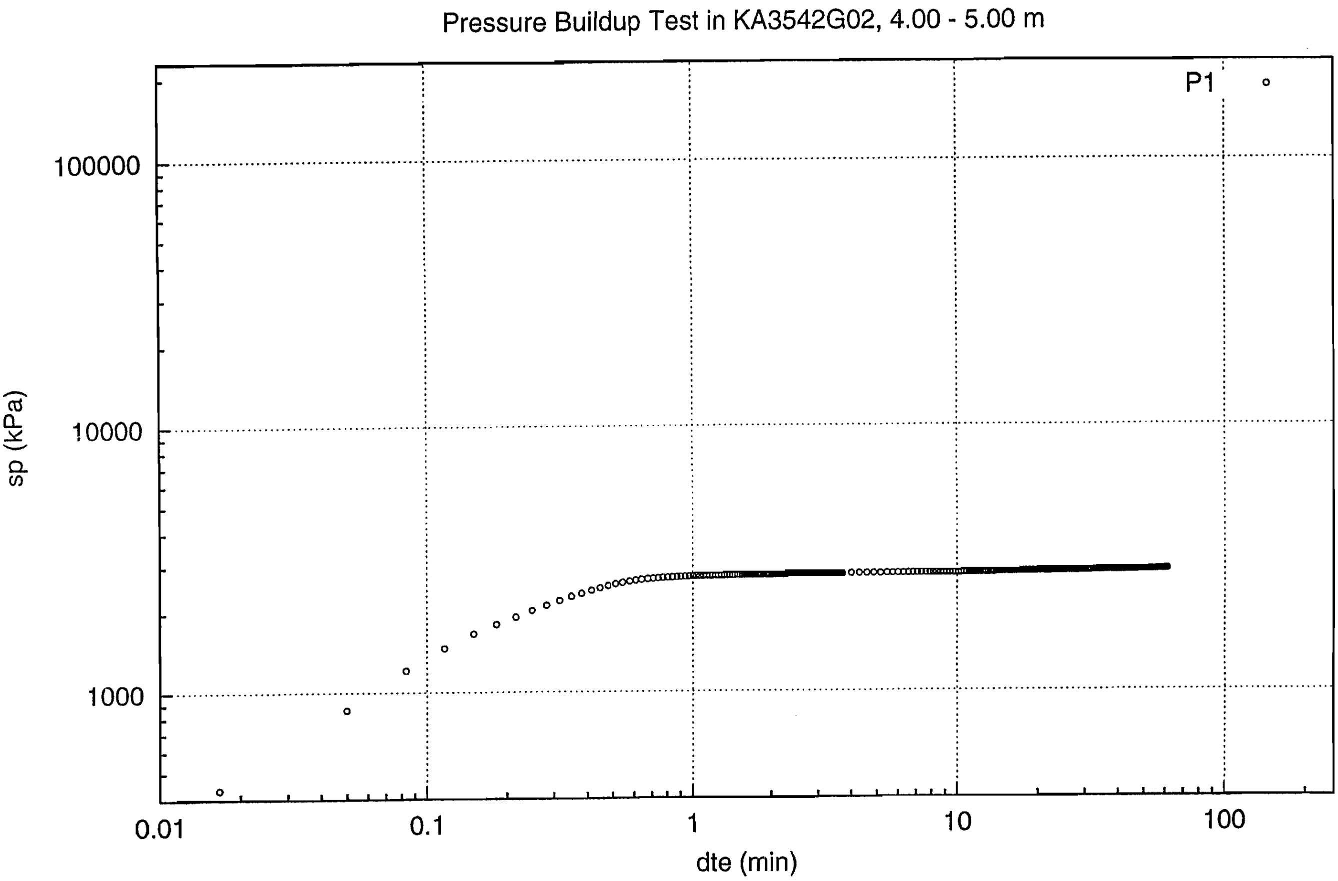
/13080198/DATA/bholeb03/utv_03/12pb3542.grf 10/01/98

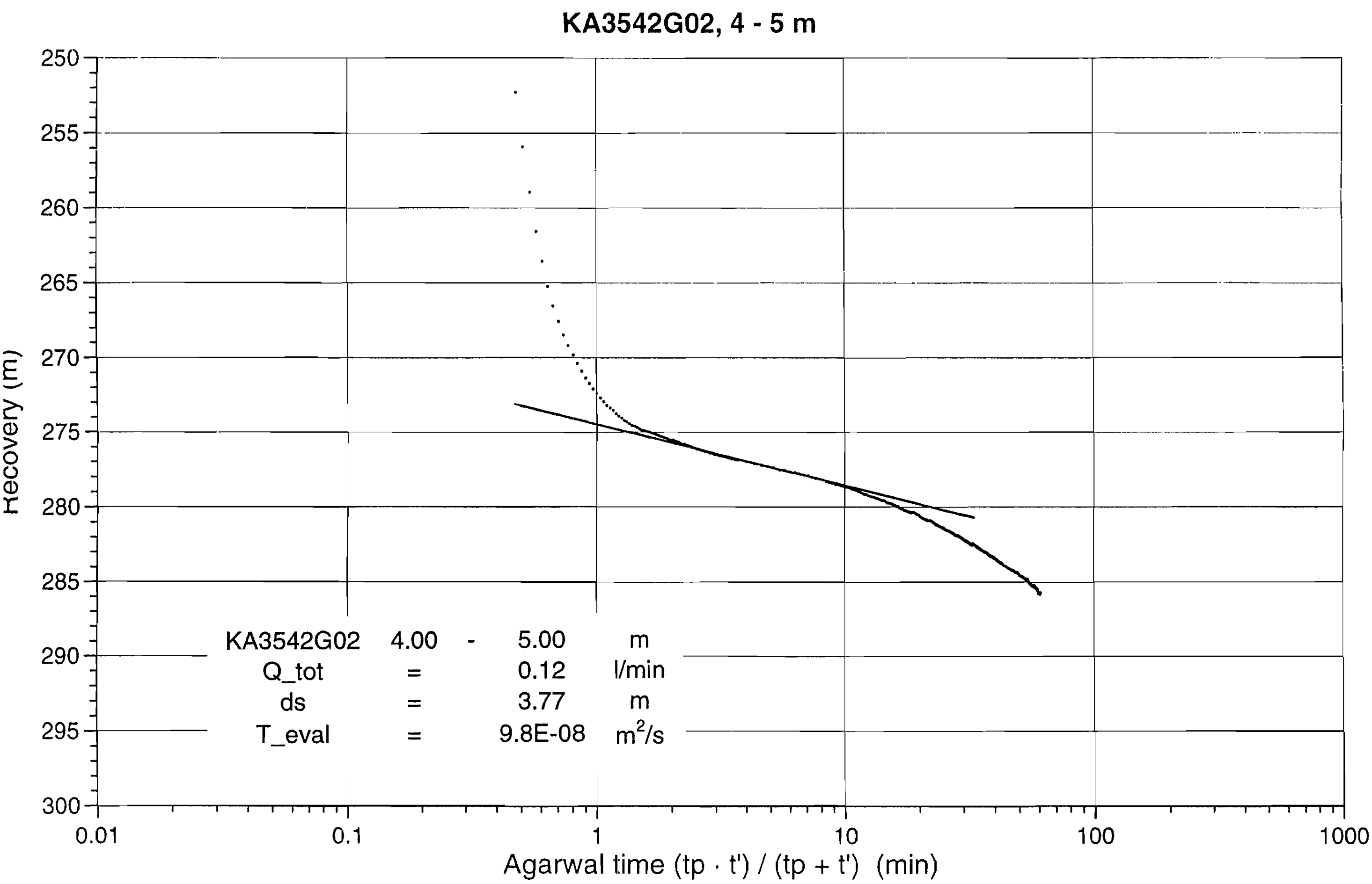






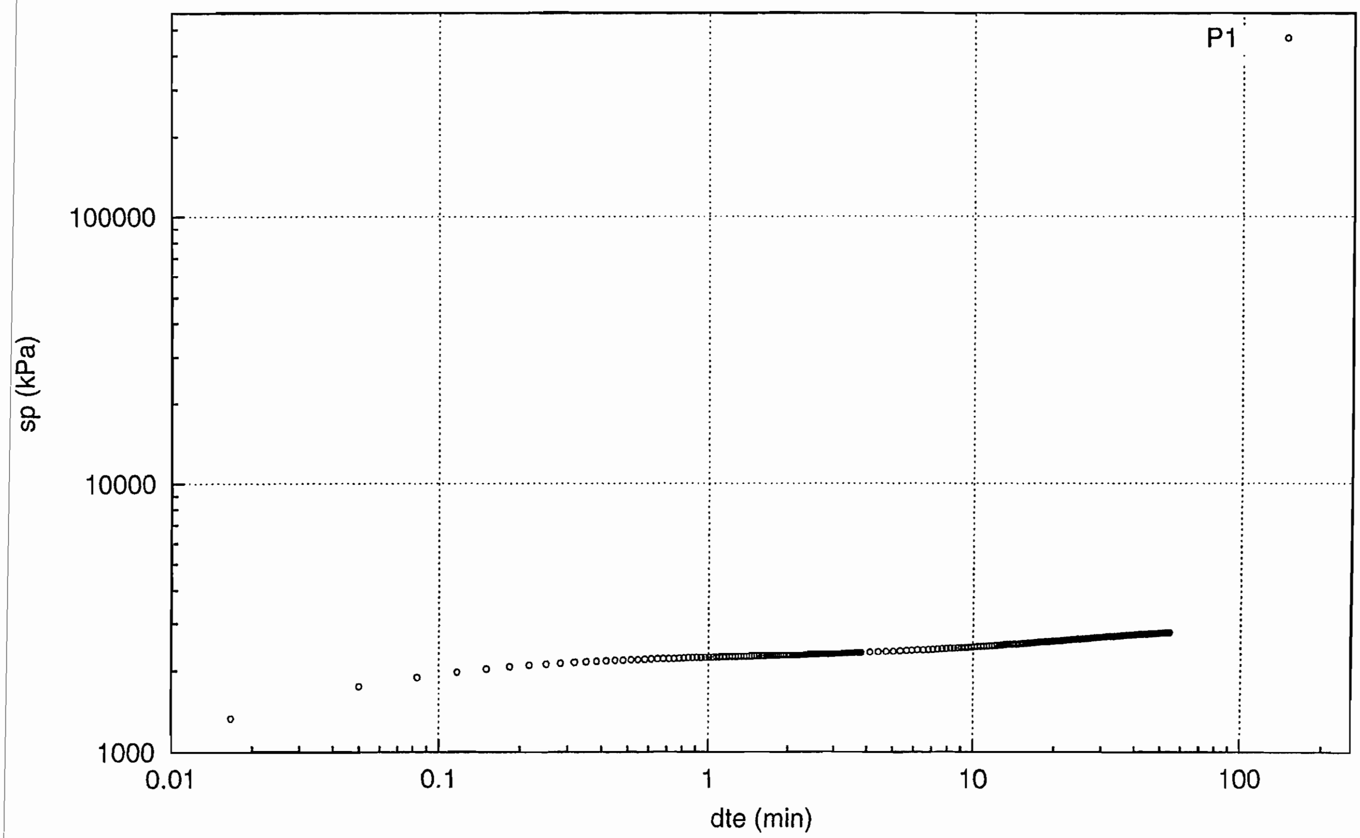
/13080198/DATA/bholeb03/utv_03/42pb3542.grf 04/22/99



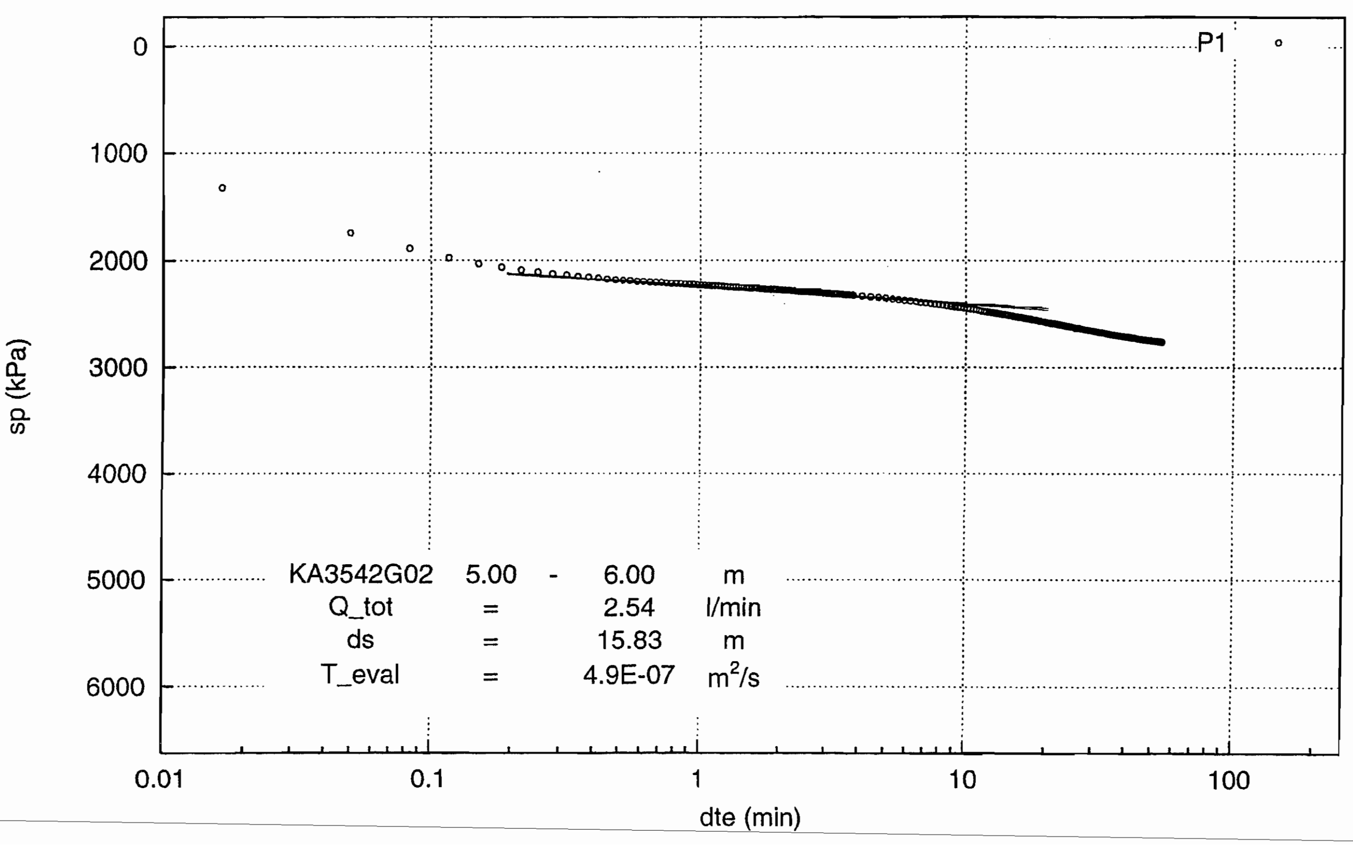


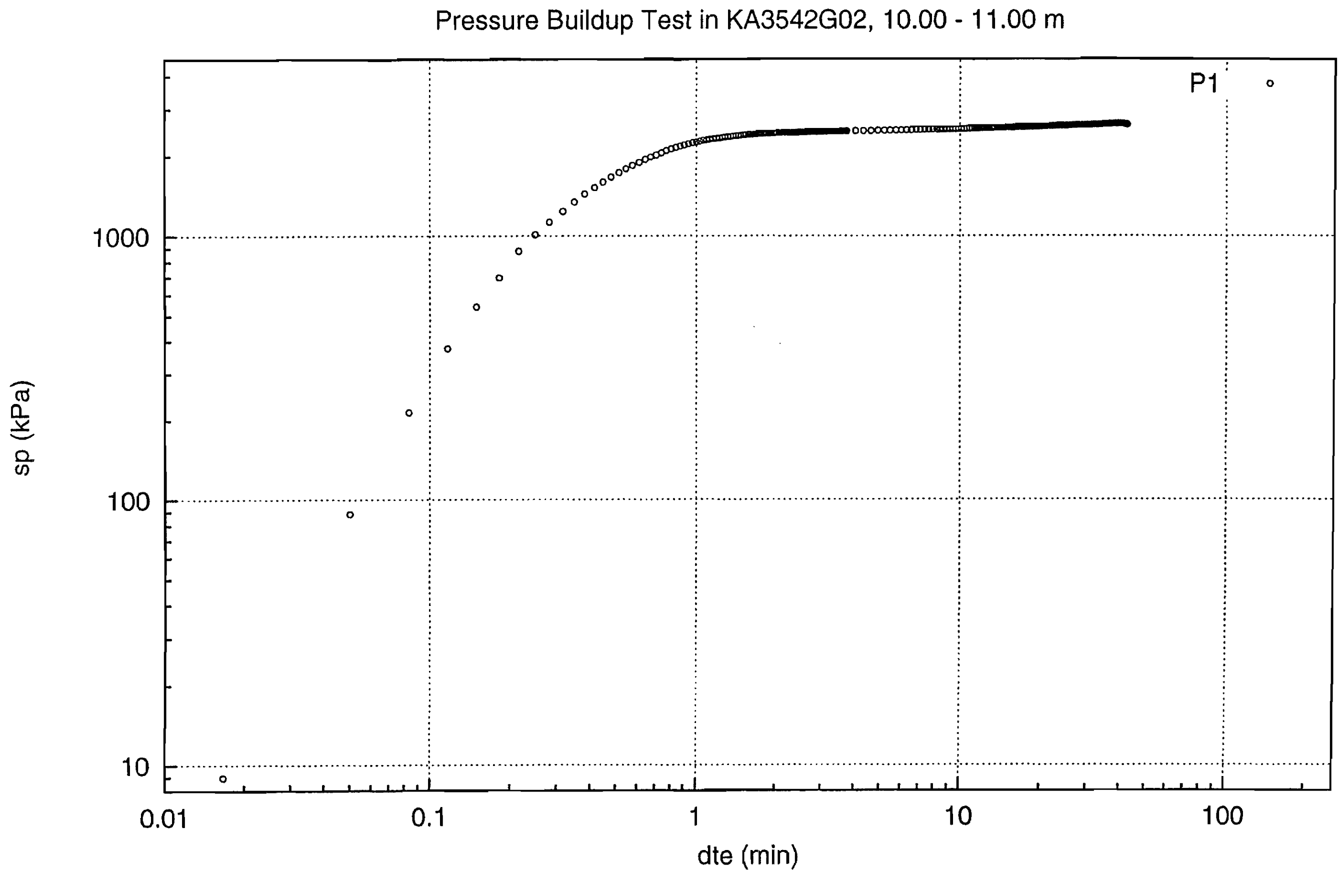
/13080198/DATA/bholeb03/utv_03/44pb3542.grf 04/22/99

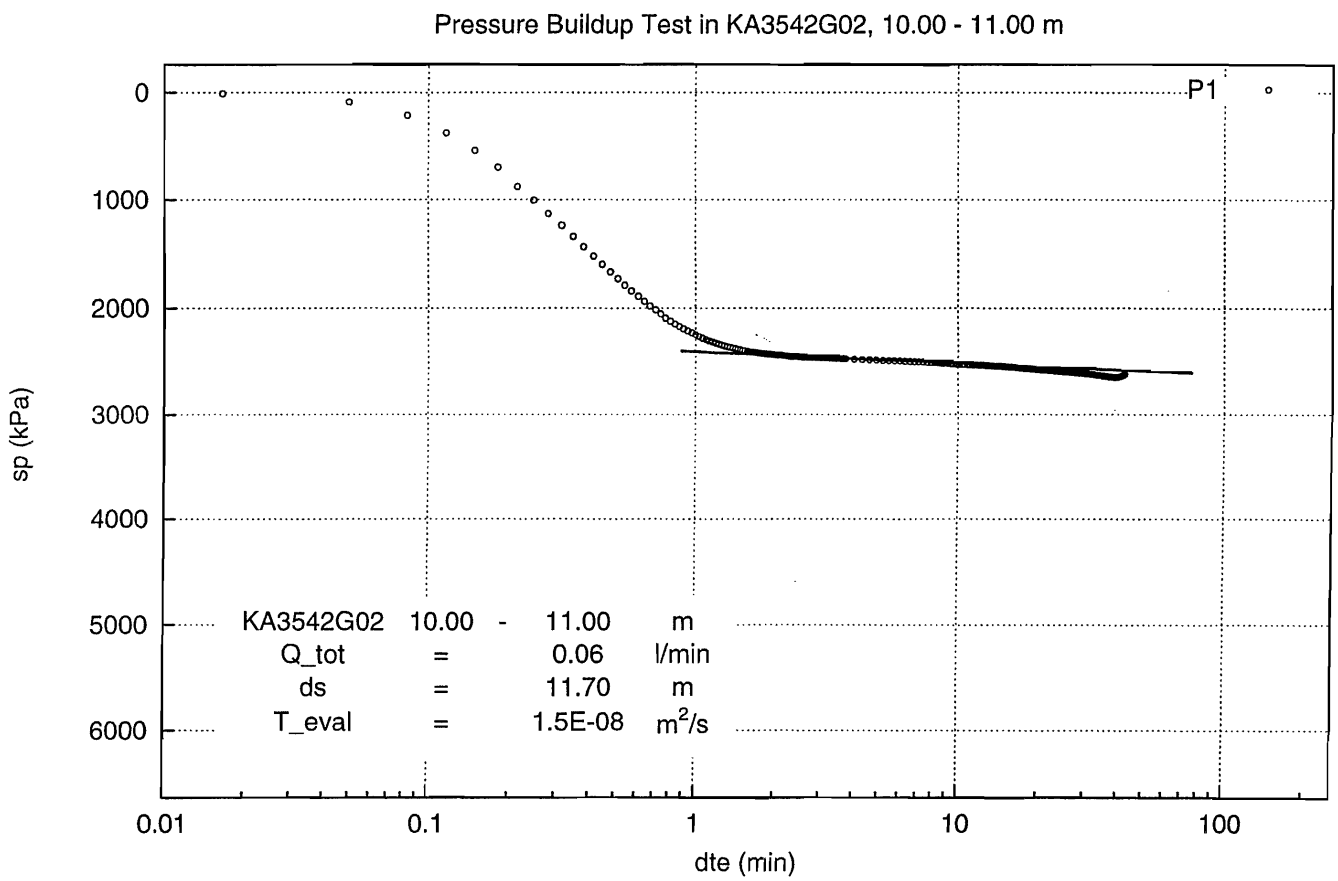
Pressure Buildup Test in KA3542G02, 5.00 - 6.00 m



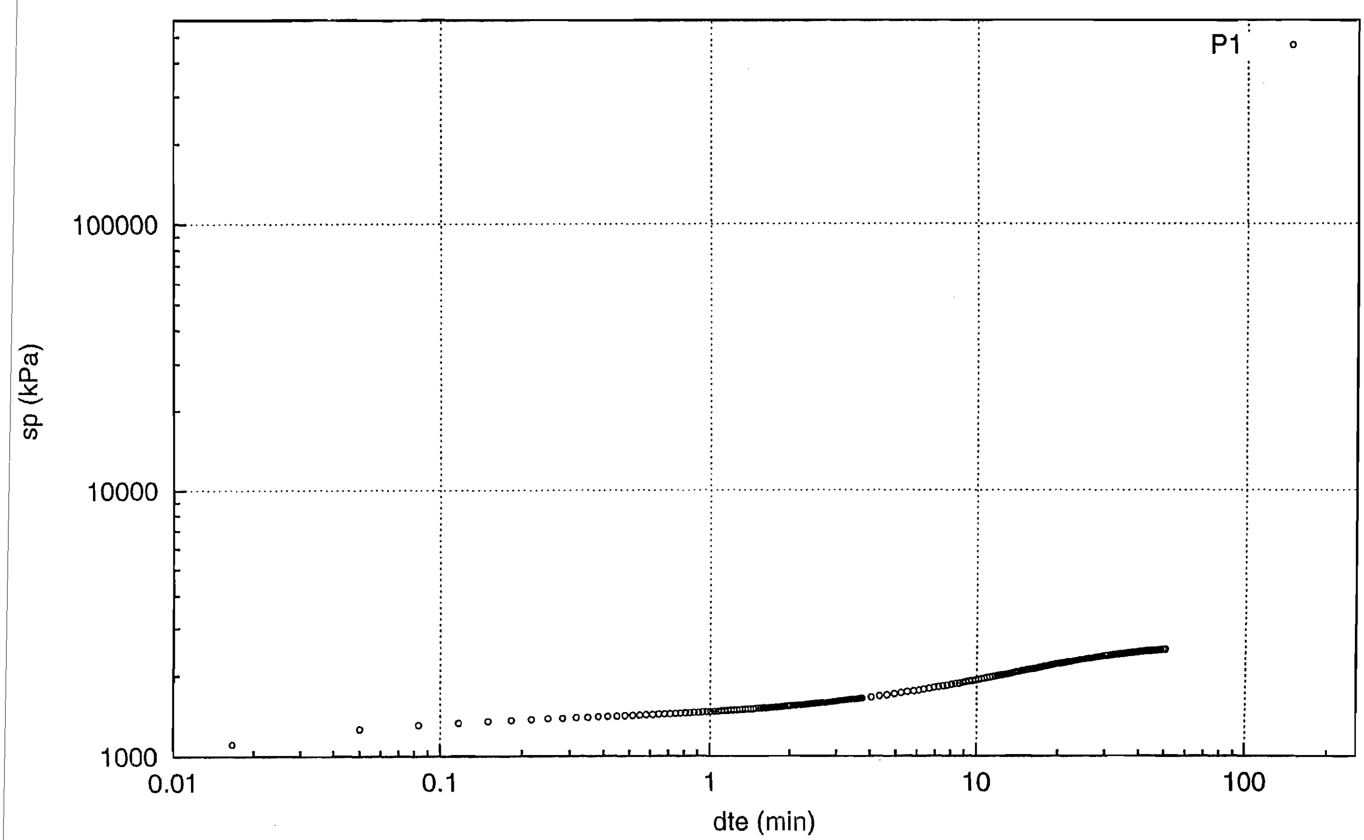
Pressure Buildup Test in KA3542G02, 5.00 - 6.00 m



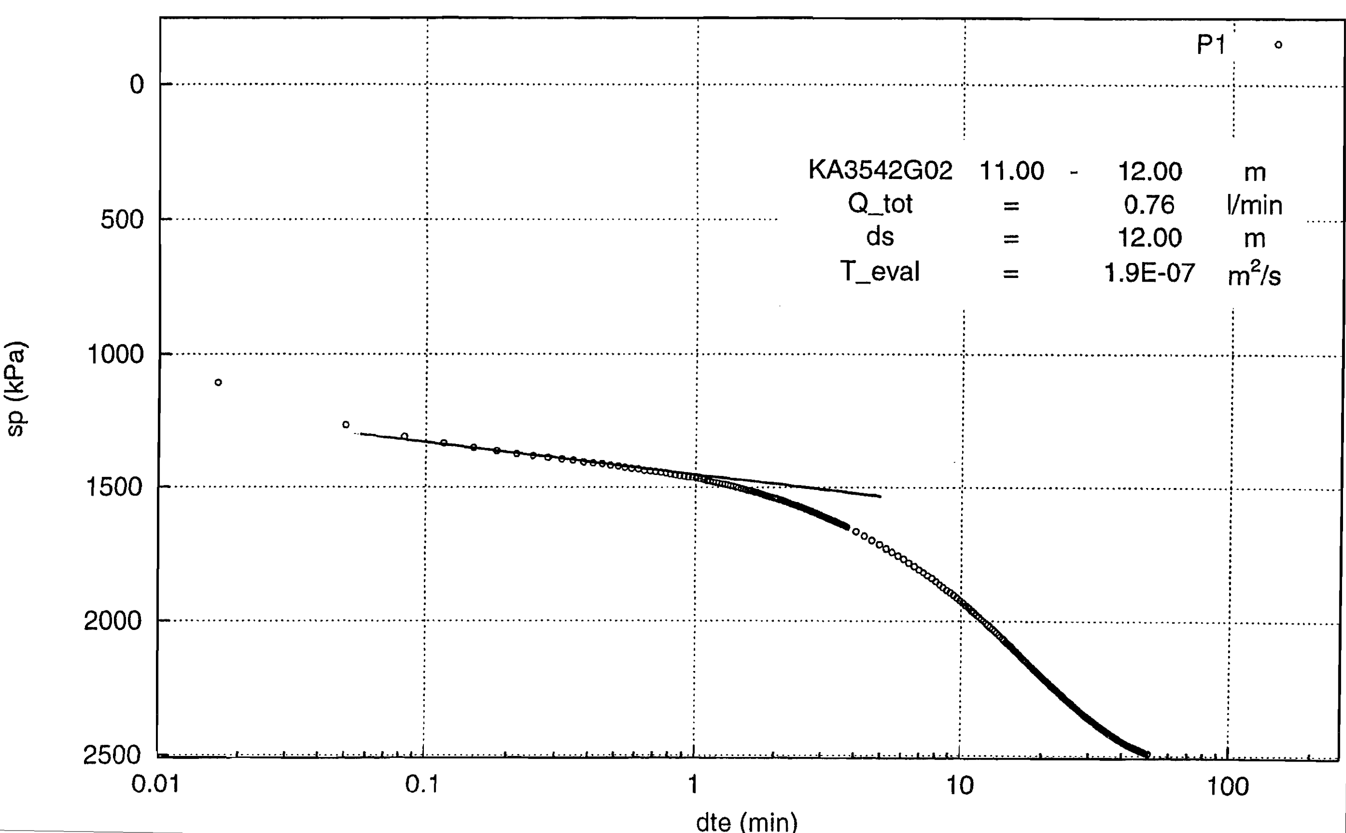

Pressure Buildup Test in KA3542G02, 10.00 - 11.00 m
P1
sp (kPa)
1000
100
10
0.01
0.1
1
10
100
dte (min)


Pressure Buildup Test in KA3542G02, 10.00 - 11.00 m
P1
sp (kPa)
0
1000
2000
3000
4000
5000
6000
KA3542G02 10.00 - 11.00 m
Q_tot = 0.06 l/min
ds = 11.70 m
T_eval = 1.5E-08 m2/s
0.01
0.1
1
10
100
dte (min)

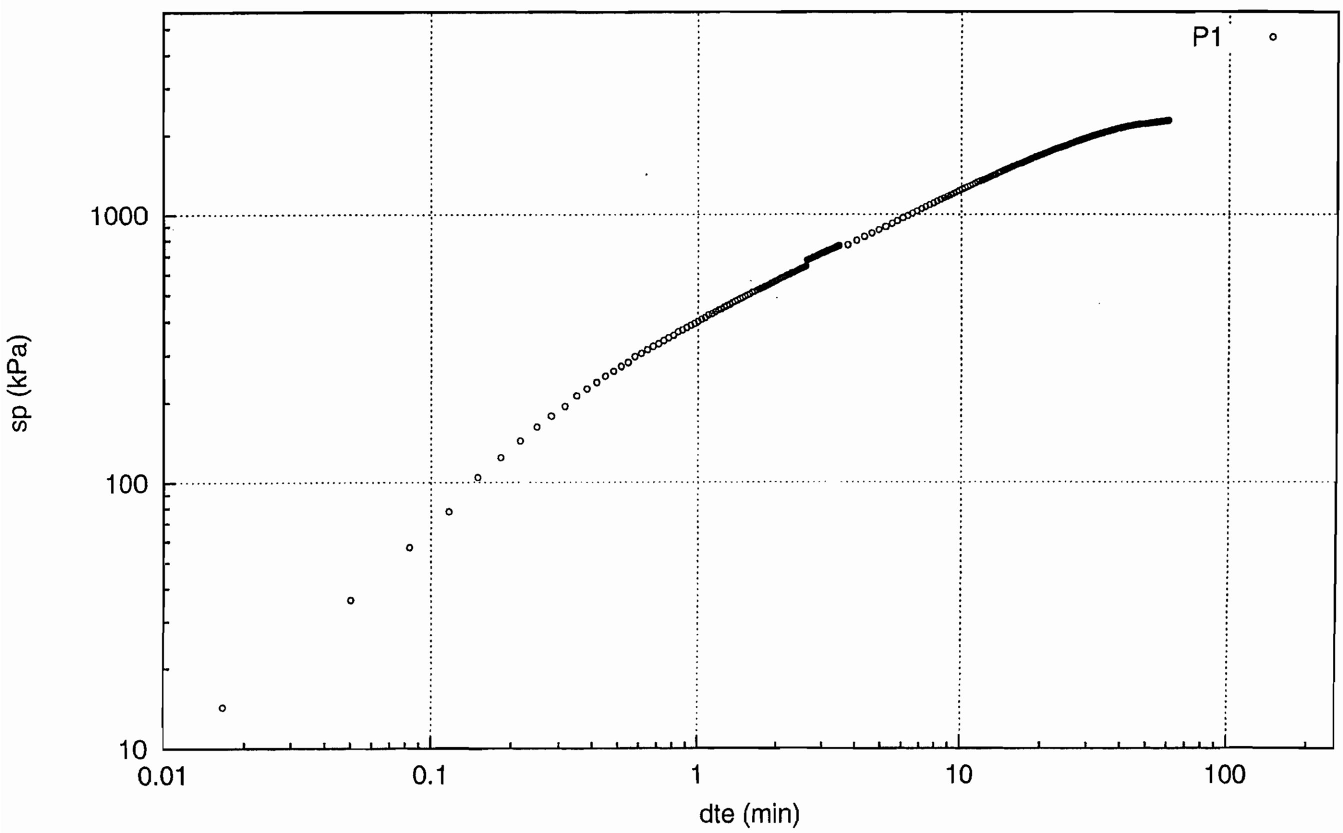
Pressure Buildup Test in KA3542G02, 11.00 - 12.00 m



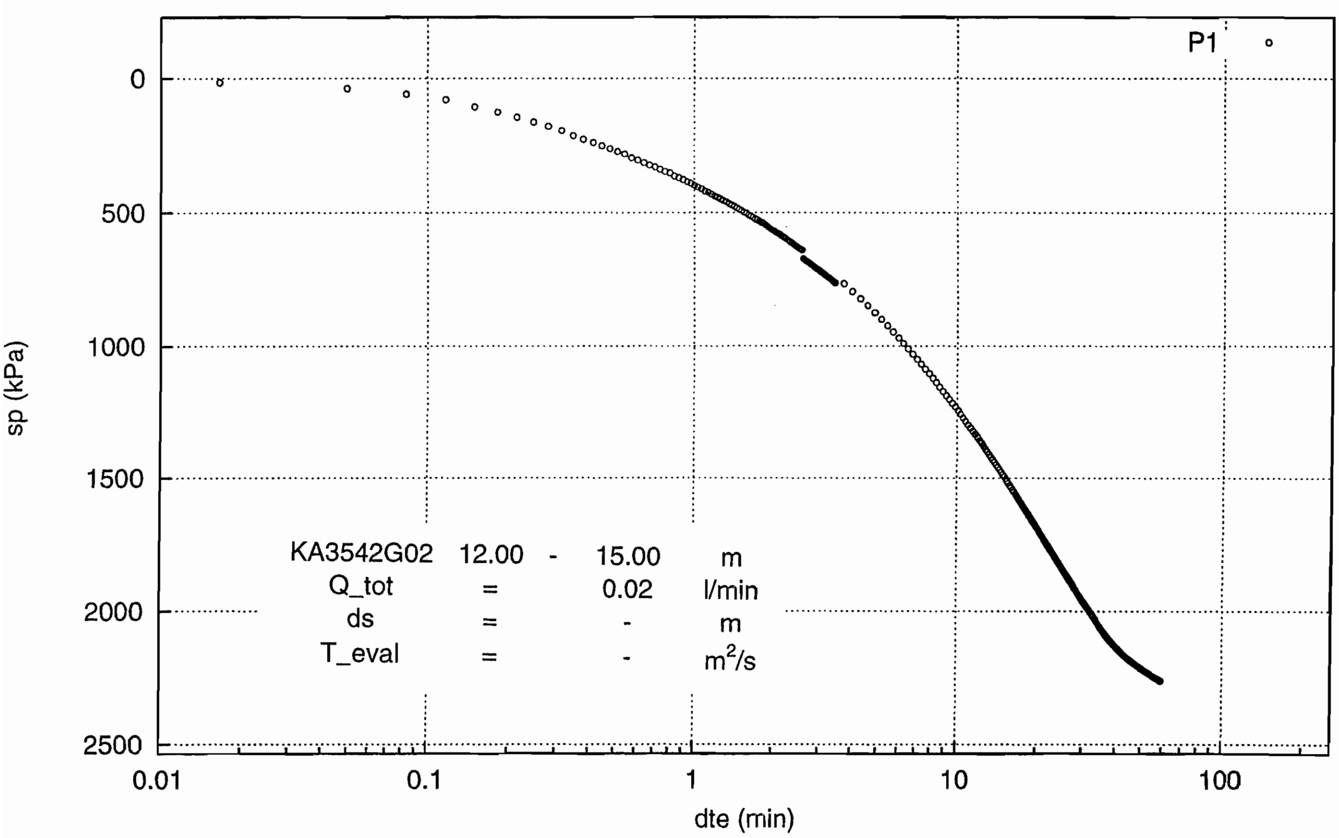
Pressure Buildup Test in KA3542G02, 11.00 - 12.00 m



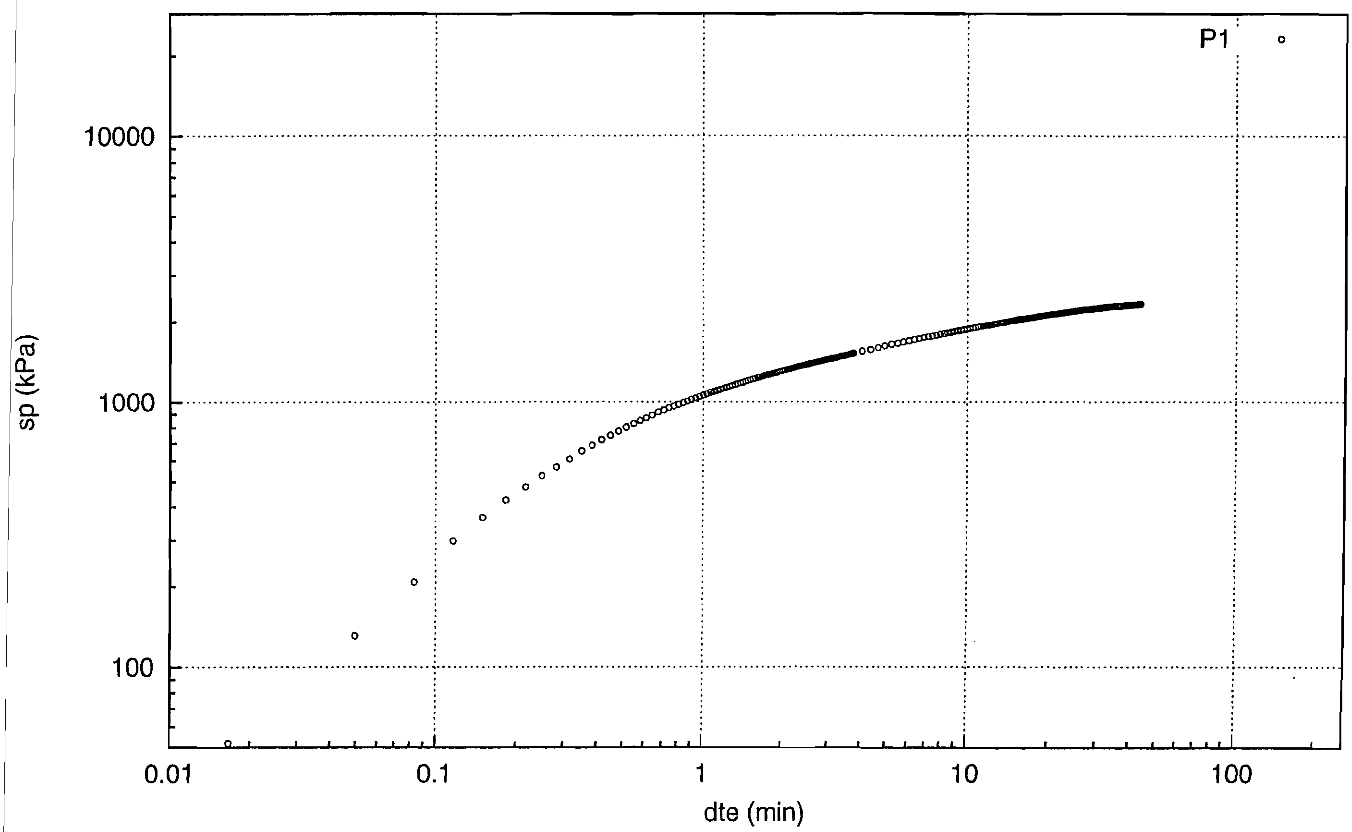
Pressure Buildup Test in KA3542G02, 12.00 - 15.00 m



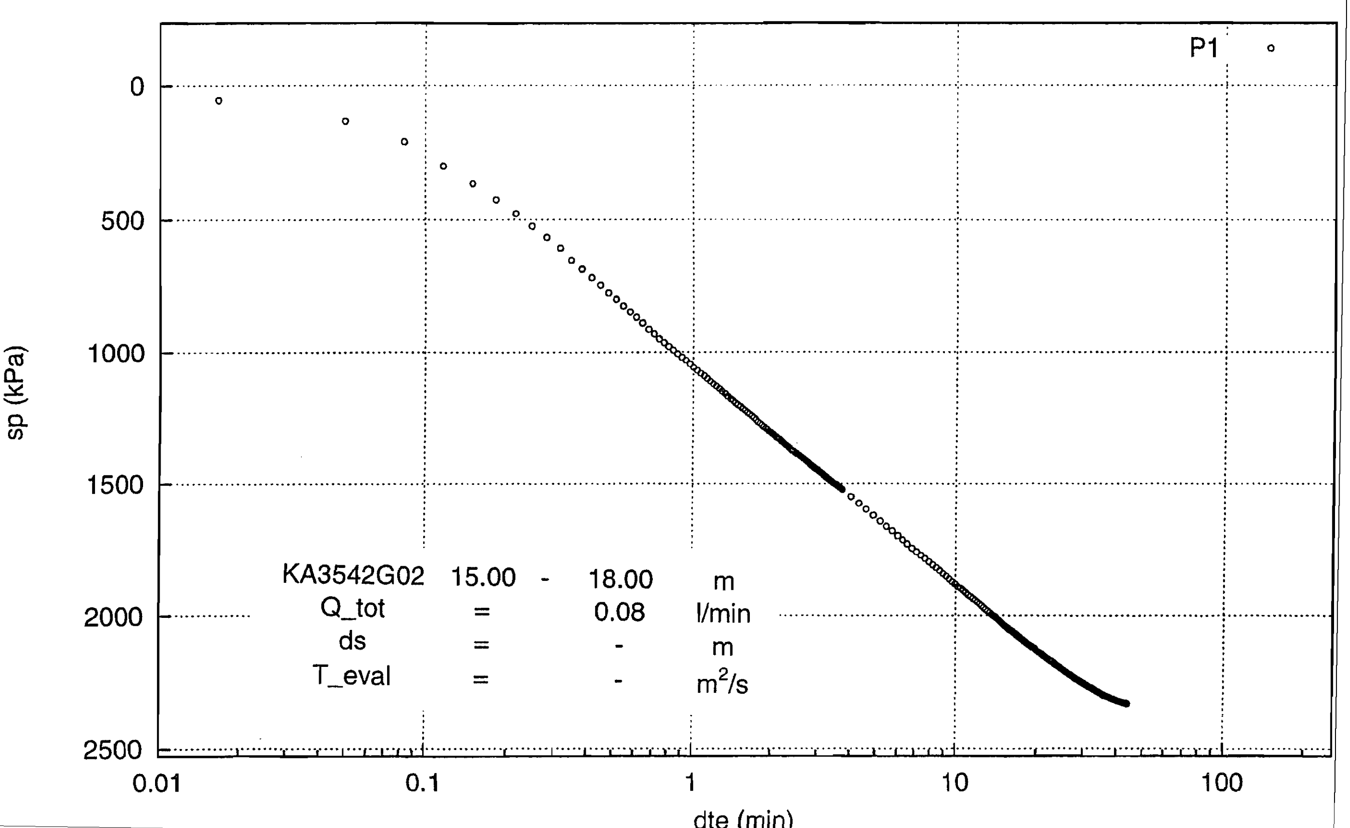
Pressure Buildup Test in KA3542G02, 12.00 - 15.00 m

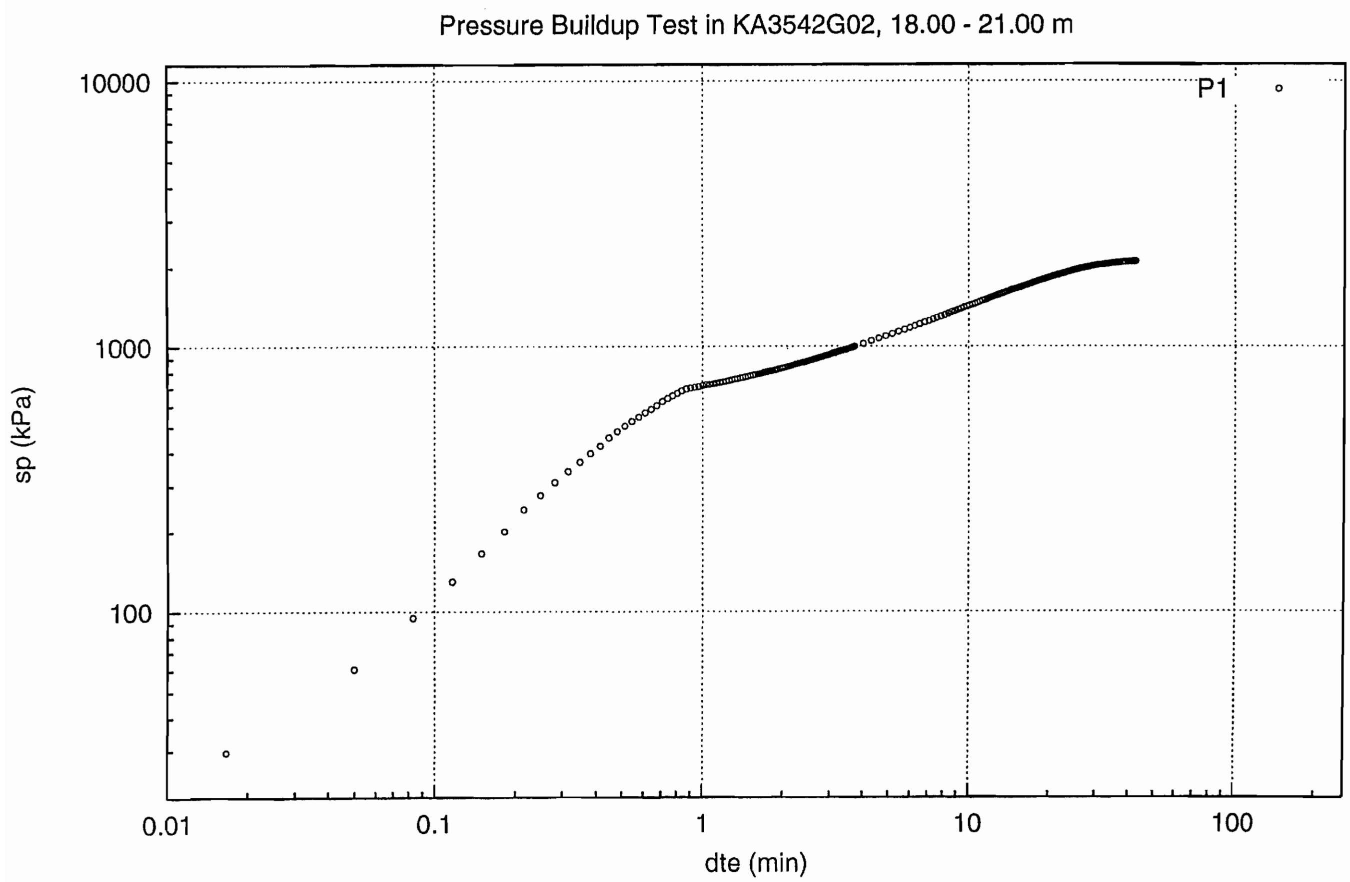


Pressure Buildup Test in KA3542G02, 15.00 - 18.00 m

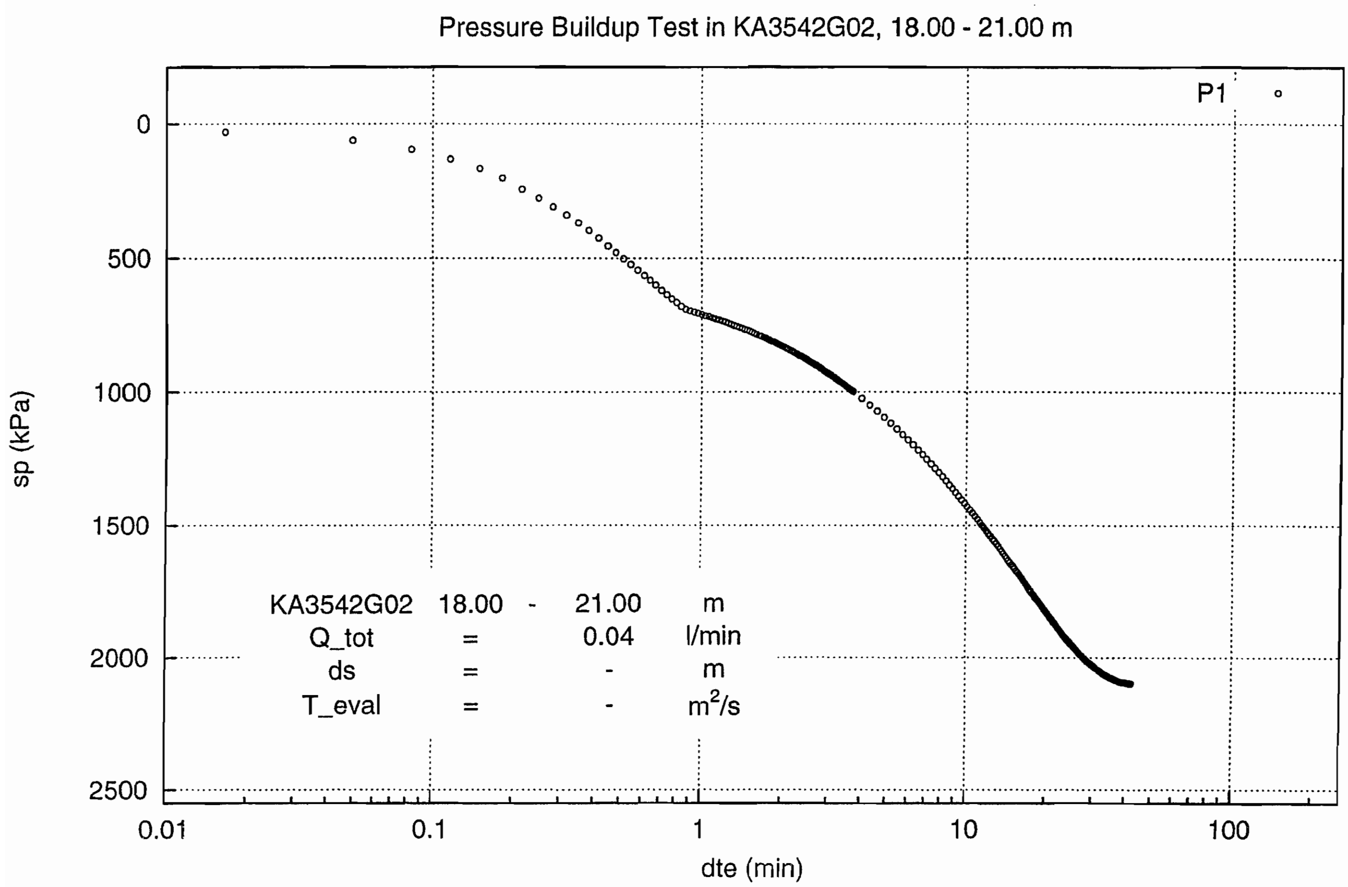


Pressure Buildup Test in KA3542G02, 15.00 - 18.00 m

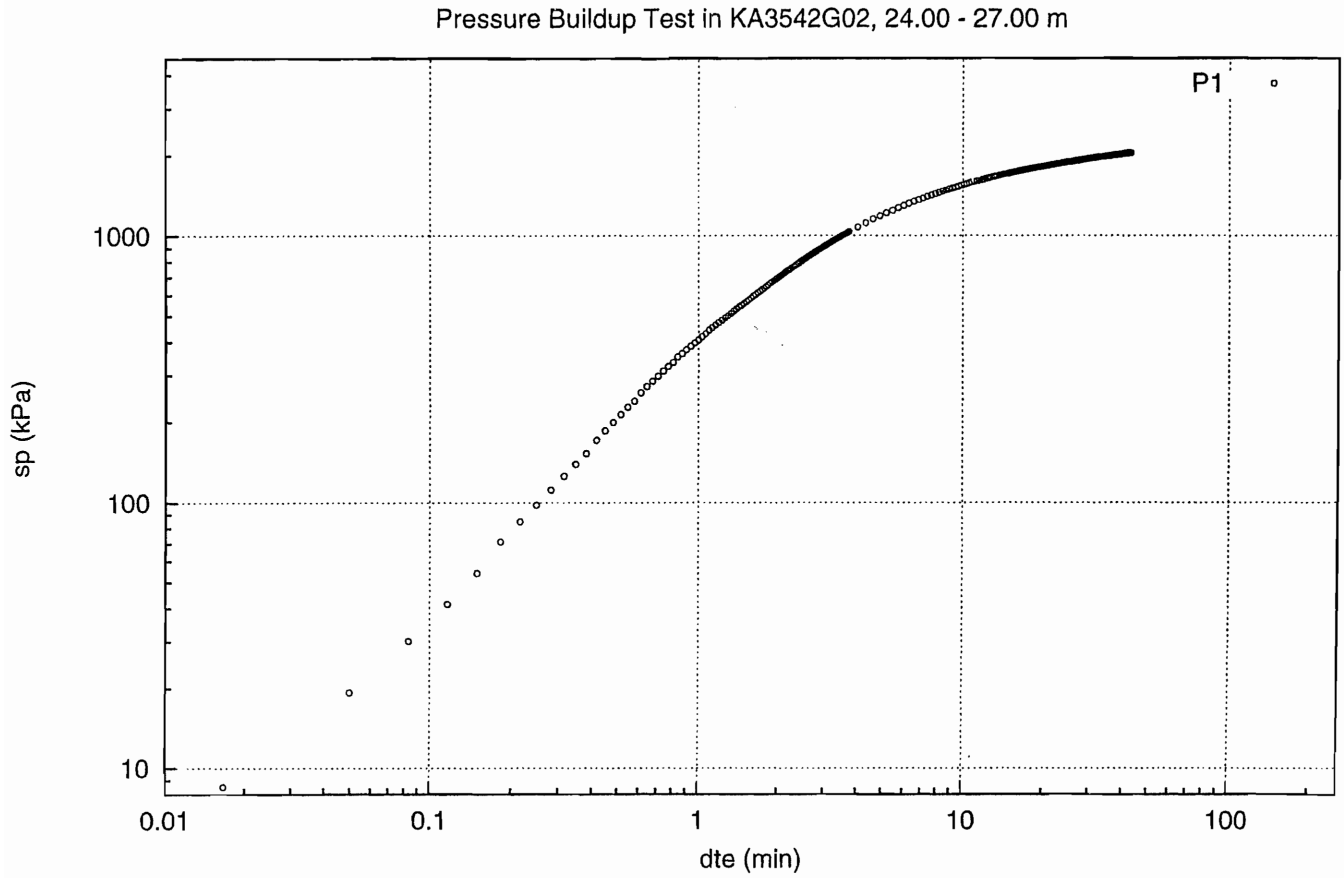




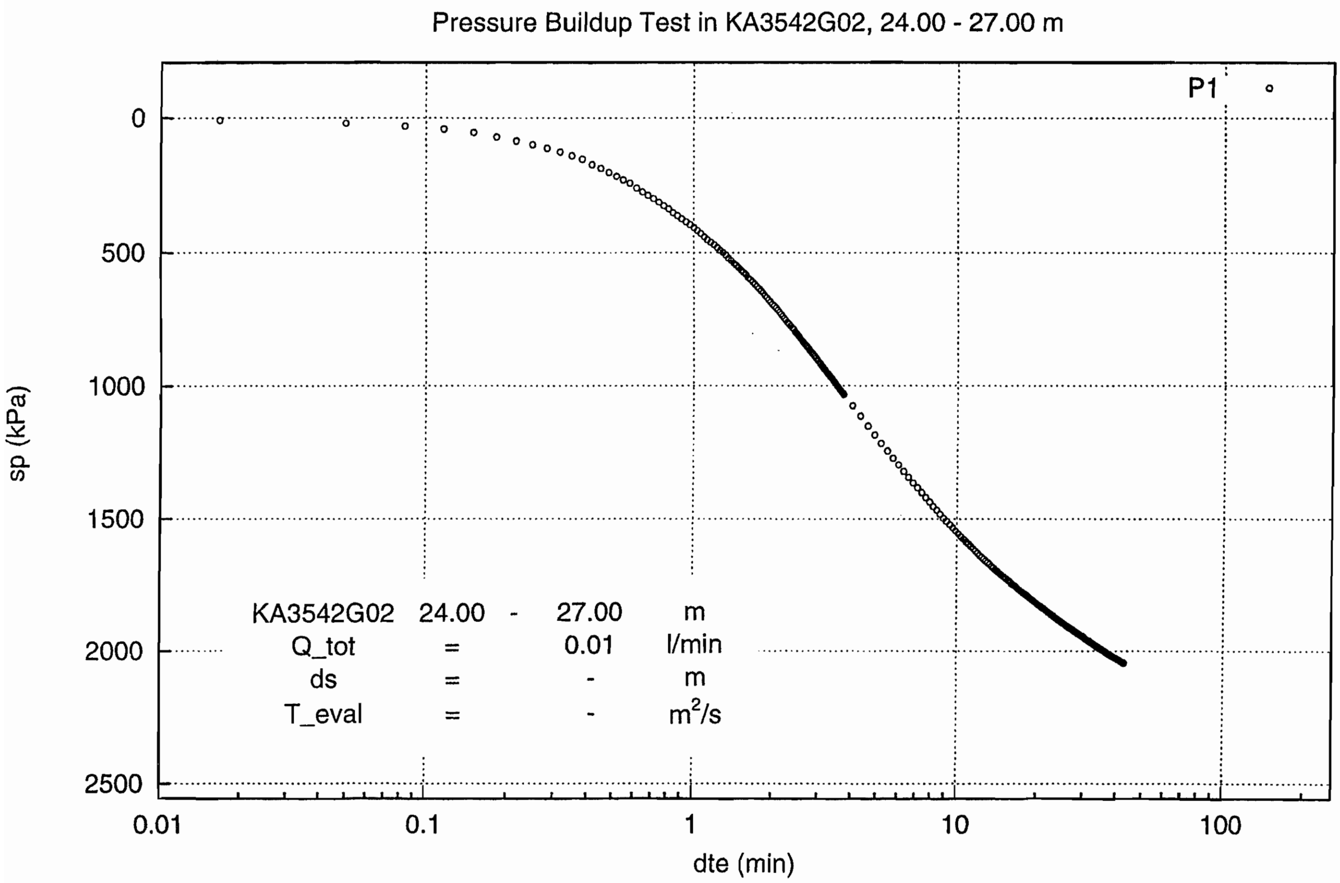
Pressure Buildup Test in KA3542G02, 18.00 - 21.00 m
P1
sp (kPa)
10000
1000
100
0.01
0.1
1
10
100
dte (min)



Pressure Buildup Test in KA3542G02, 18.00 - 21.00 m
P1
sp (kPa)
0
500
1000
1500
2000
2500
KA3542G02 18.00 - 21.00 m
Q_tot = 0.04 l/min
ds = - m
T_eval = - m²/s
0.01
0.1
1
10
100
dte (min)

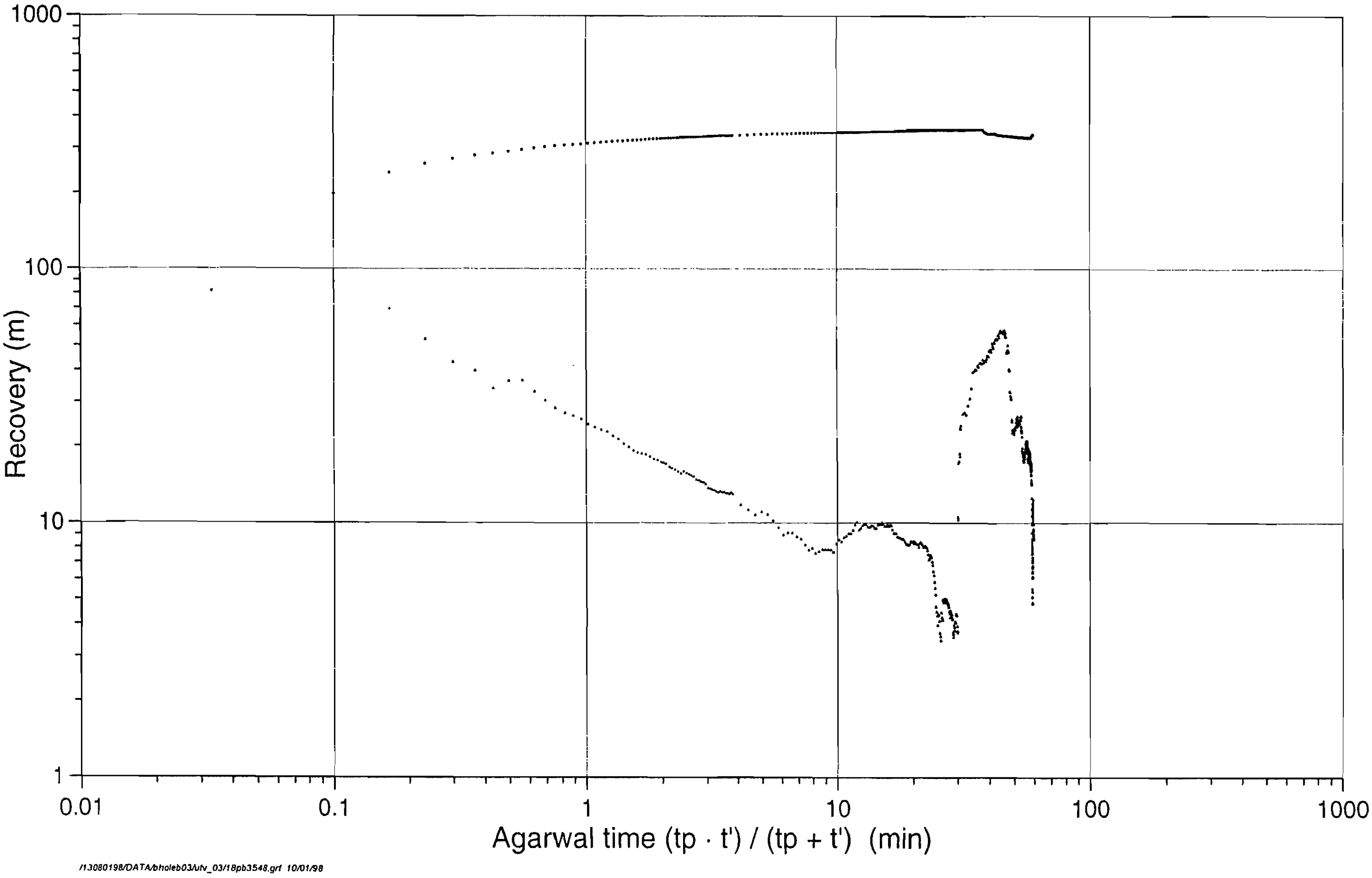


Pressure Buildup Test in KA3542G02, 24.00 - 27.00 m
P1
sp (kPa)
10
100
1000
0.01
0.1
1
10
100
dte (min)

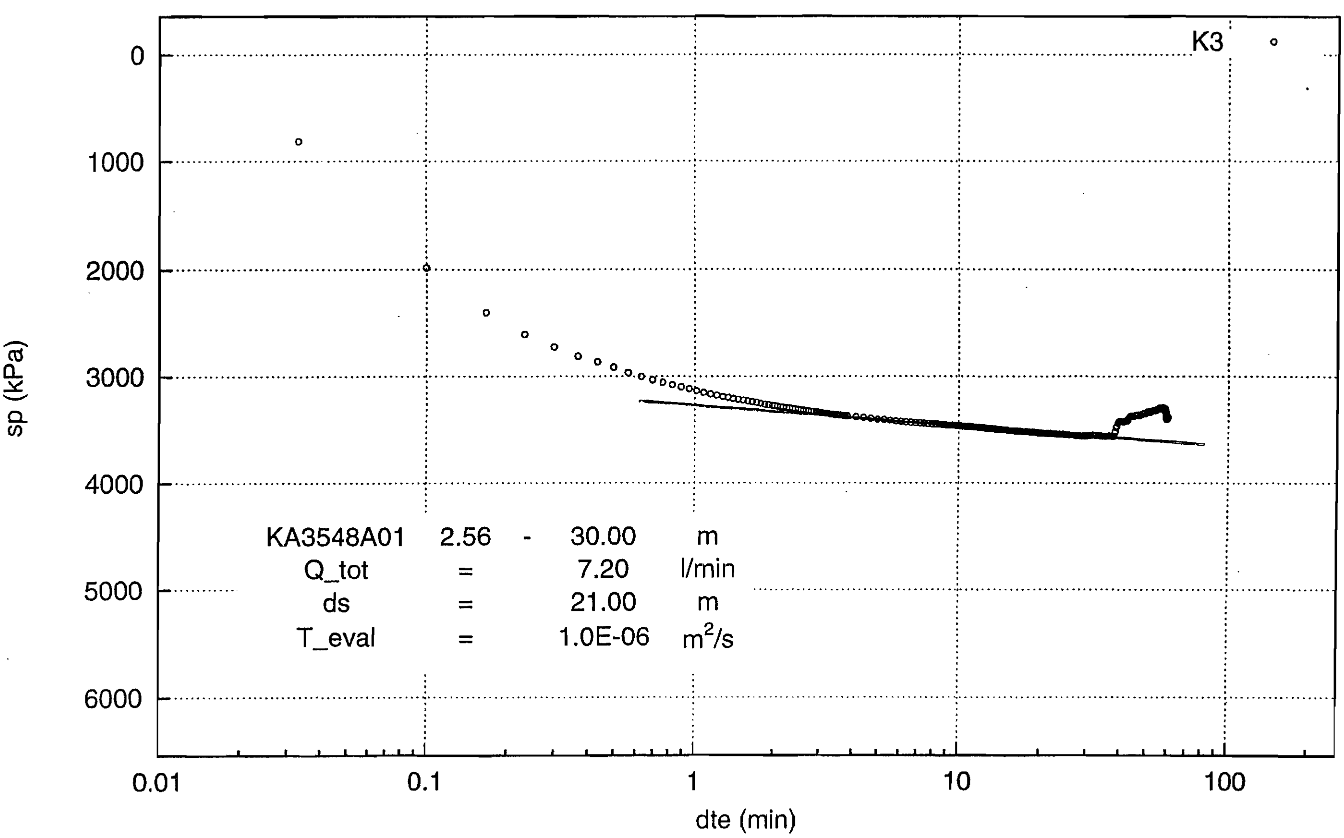


Pressure Buildup Test in KA3542G02, 24.00 - 27.00 m
P1
sp (kPa)
0
500
1000
1500
2000
2500
KA3542G02 24.00 - 27.00 m
Q_tot = 0.01 l/min
ds = - m
T_eval = - m²/s
0.01
0.1
1
10
100
dte (min)

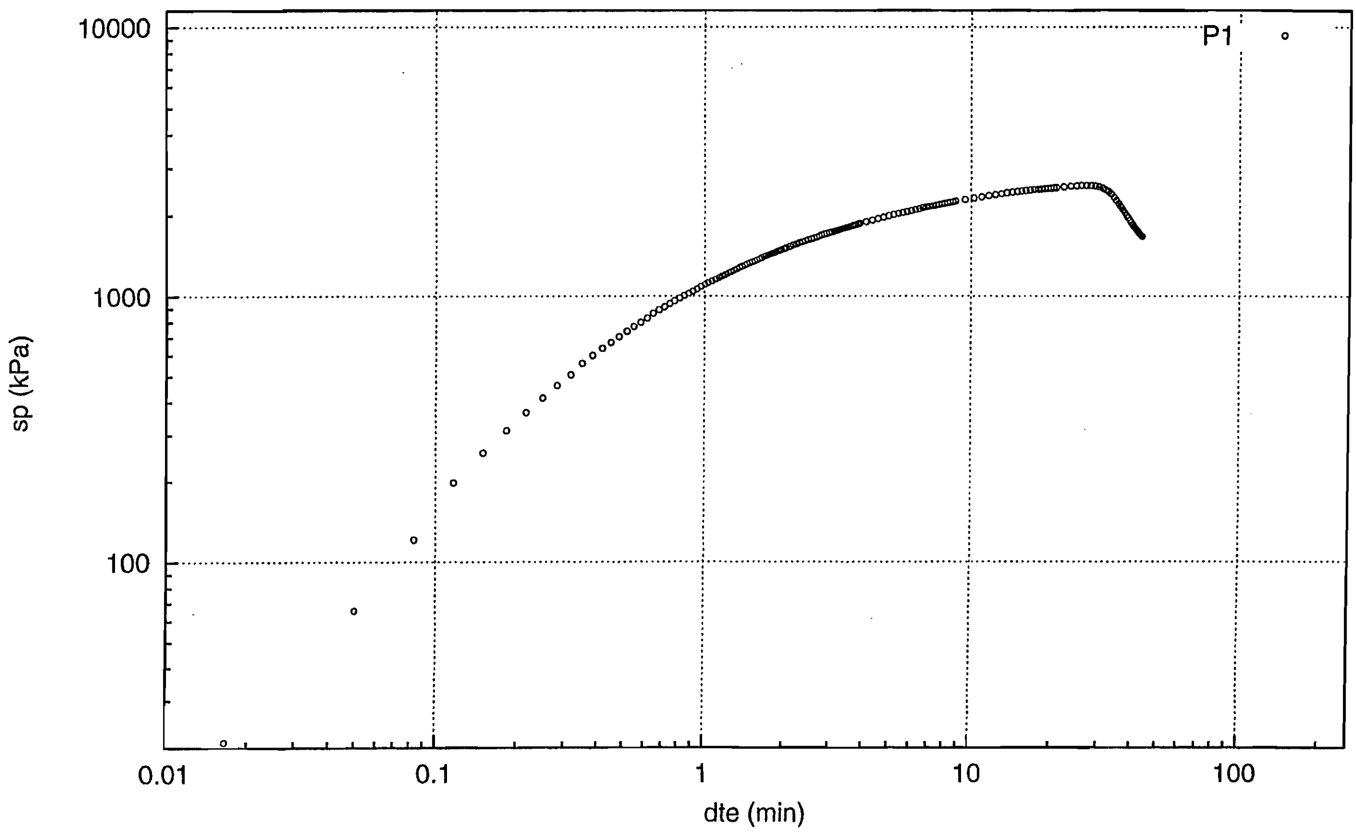
KA3548A01, 2.56 - 30.00 m



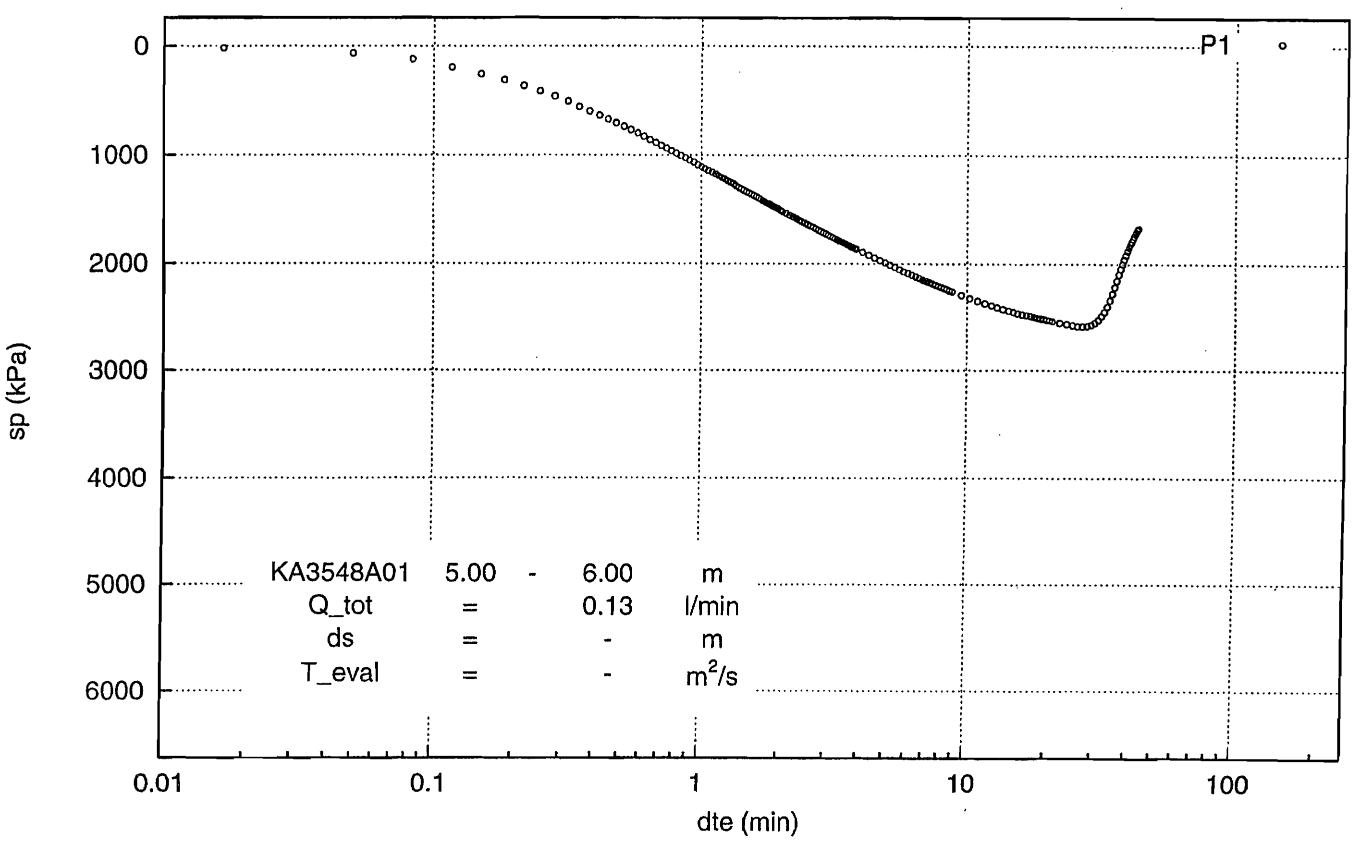
Interference test (recovery) in KA3548A01(K3)

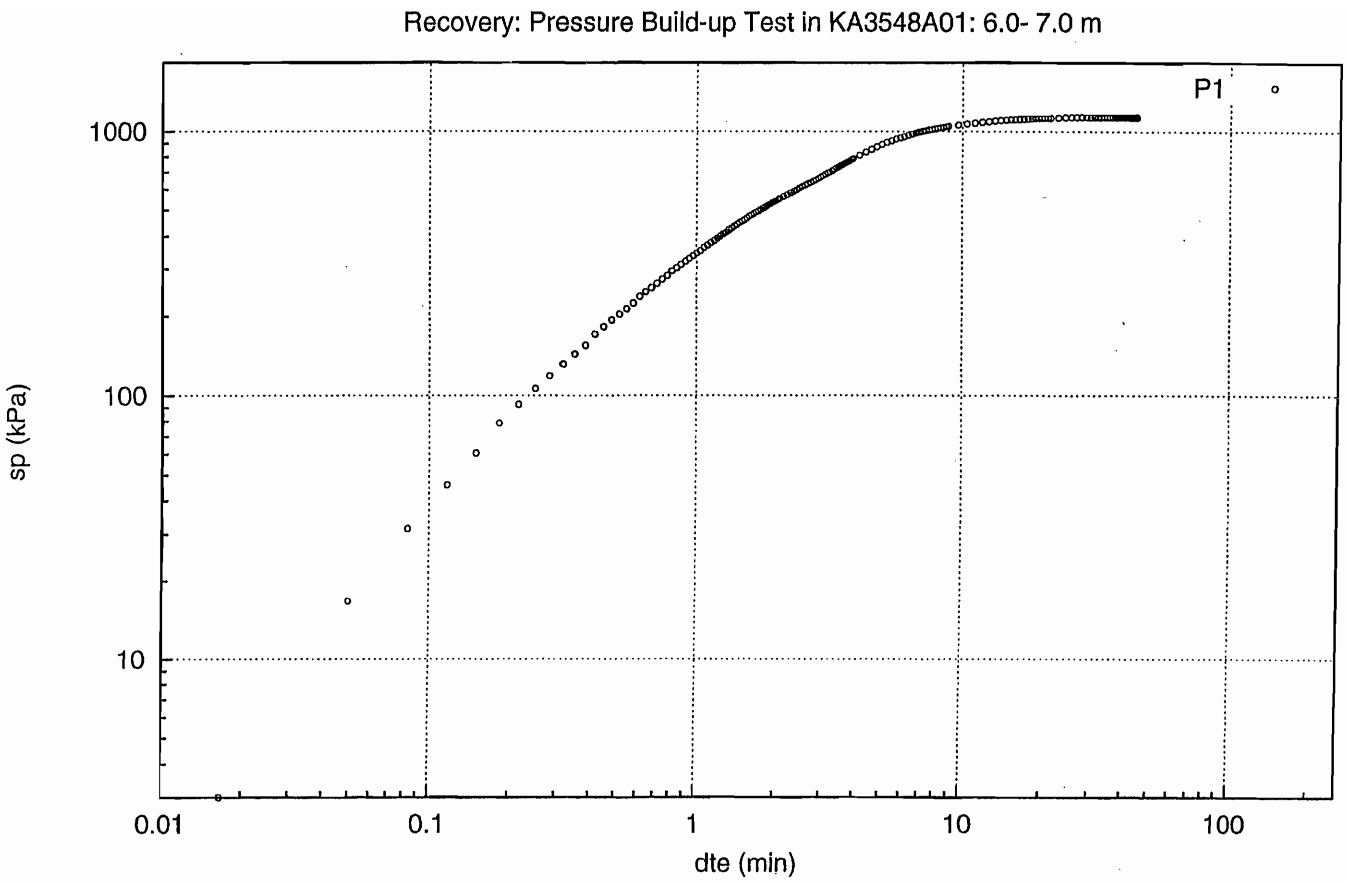


Recovery:Pressure Build-up Test in KA3548A01: 5.0- 6.0 m

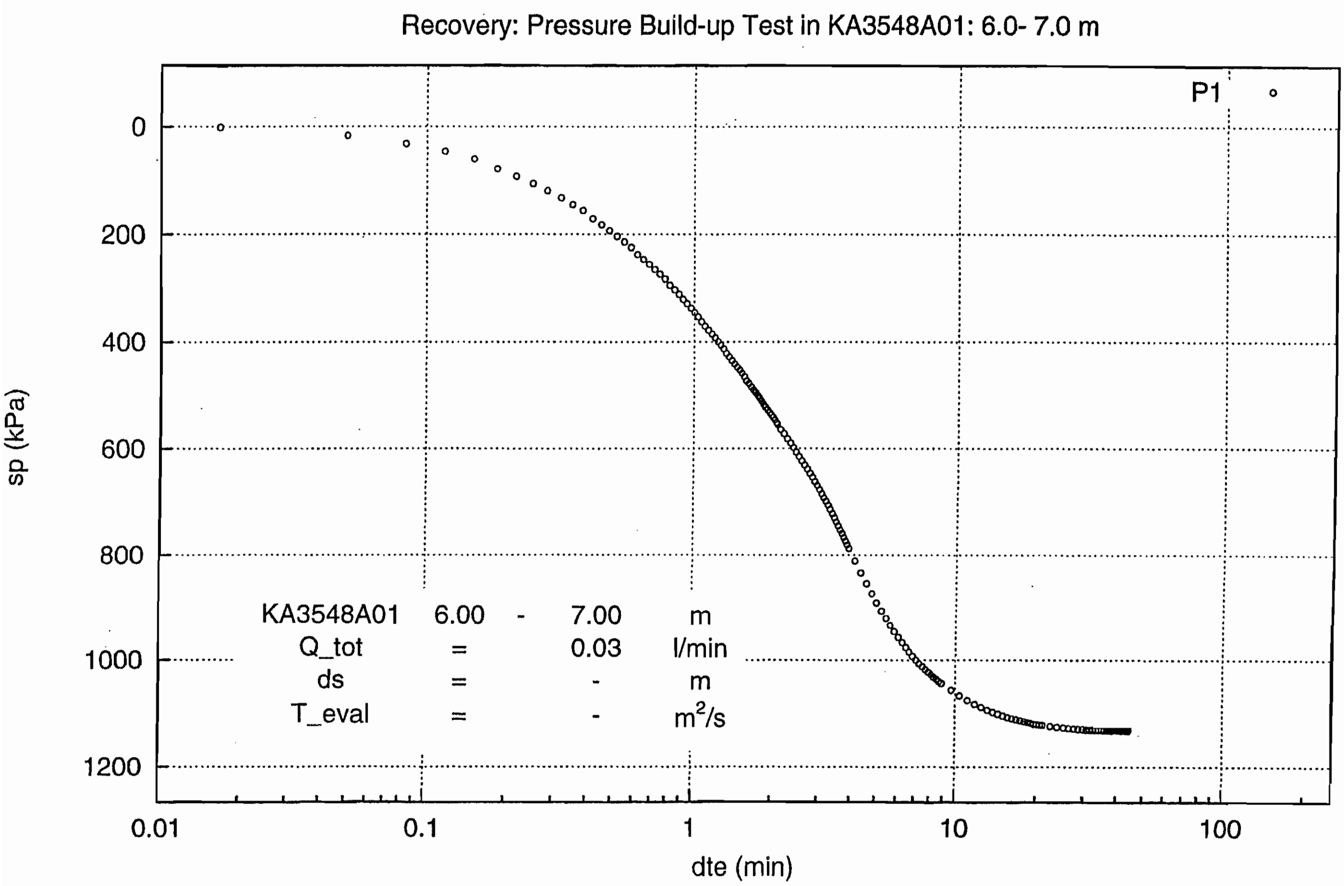


Recovery:Pressure Build-up Test in KA3548A01: 5.0- 6.0 m

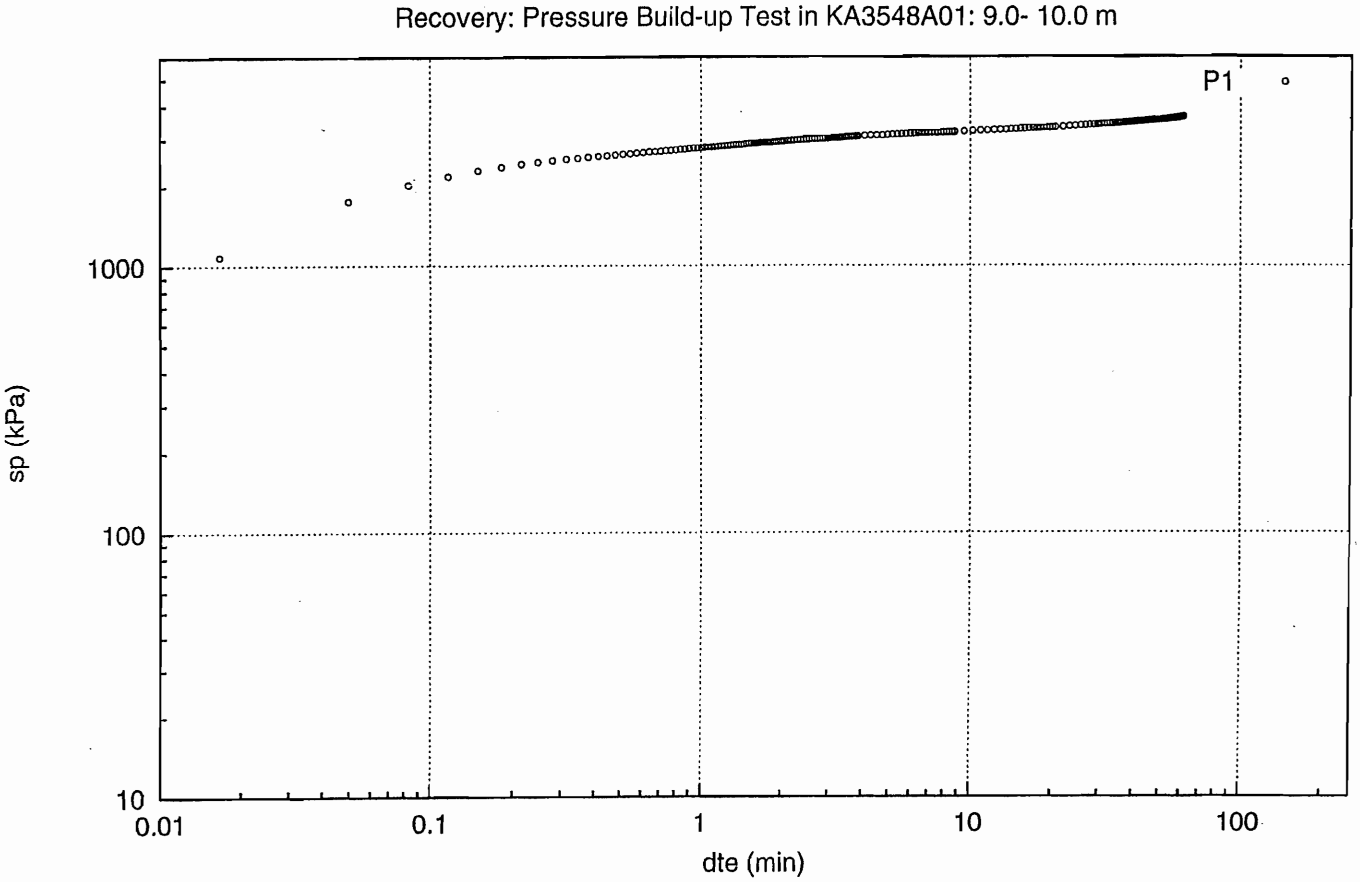




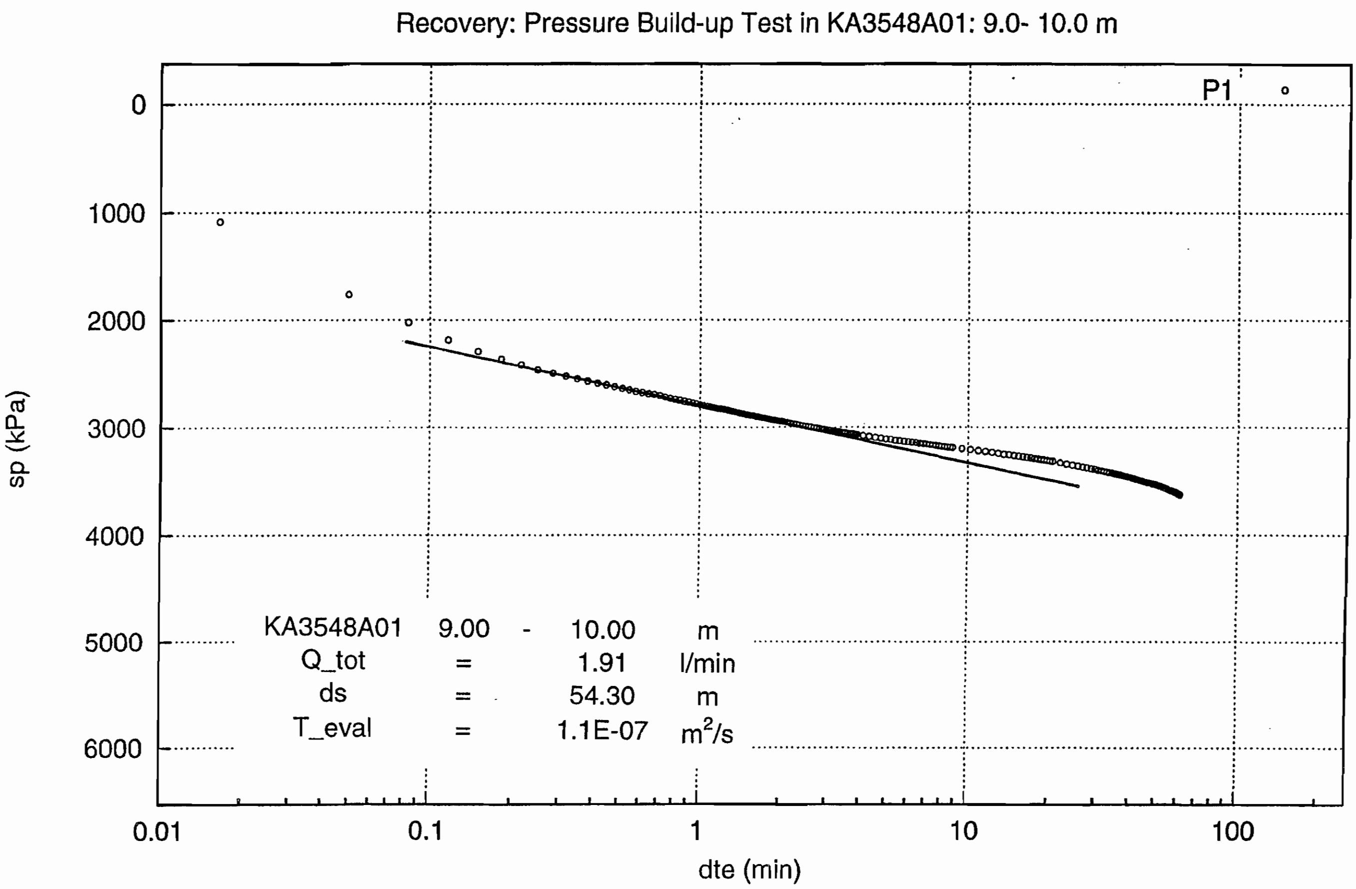
Recovery: Pressure Build-up Test in KA3548A01: 6.0- 7.0 m
P1
1000
100
10
sp (kPa)
0.01
0.1
1
10
100
dte (min)



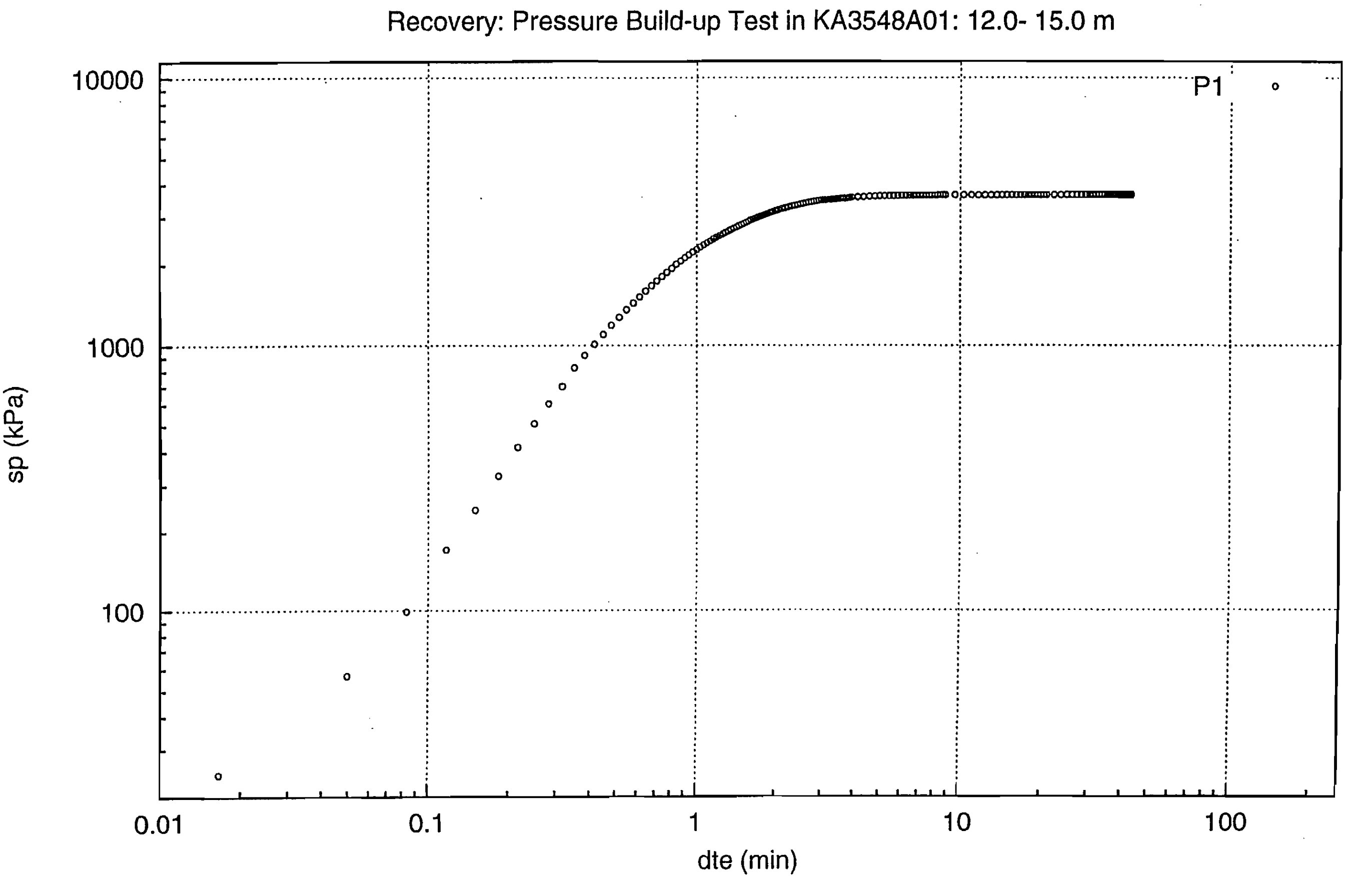
Recovery: Pressure Build-up Test in KA3548A01: 6.0- 7.0 m
P1
0
200
400
600
800
1000
1200
sp (kPa)
KA3548A01 6.00 - 7.00 m
Q_tot = 0.03 l/min
ds = - m
T_eval = - m²/s
0.01
0.1
1
10
100
dte (min)



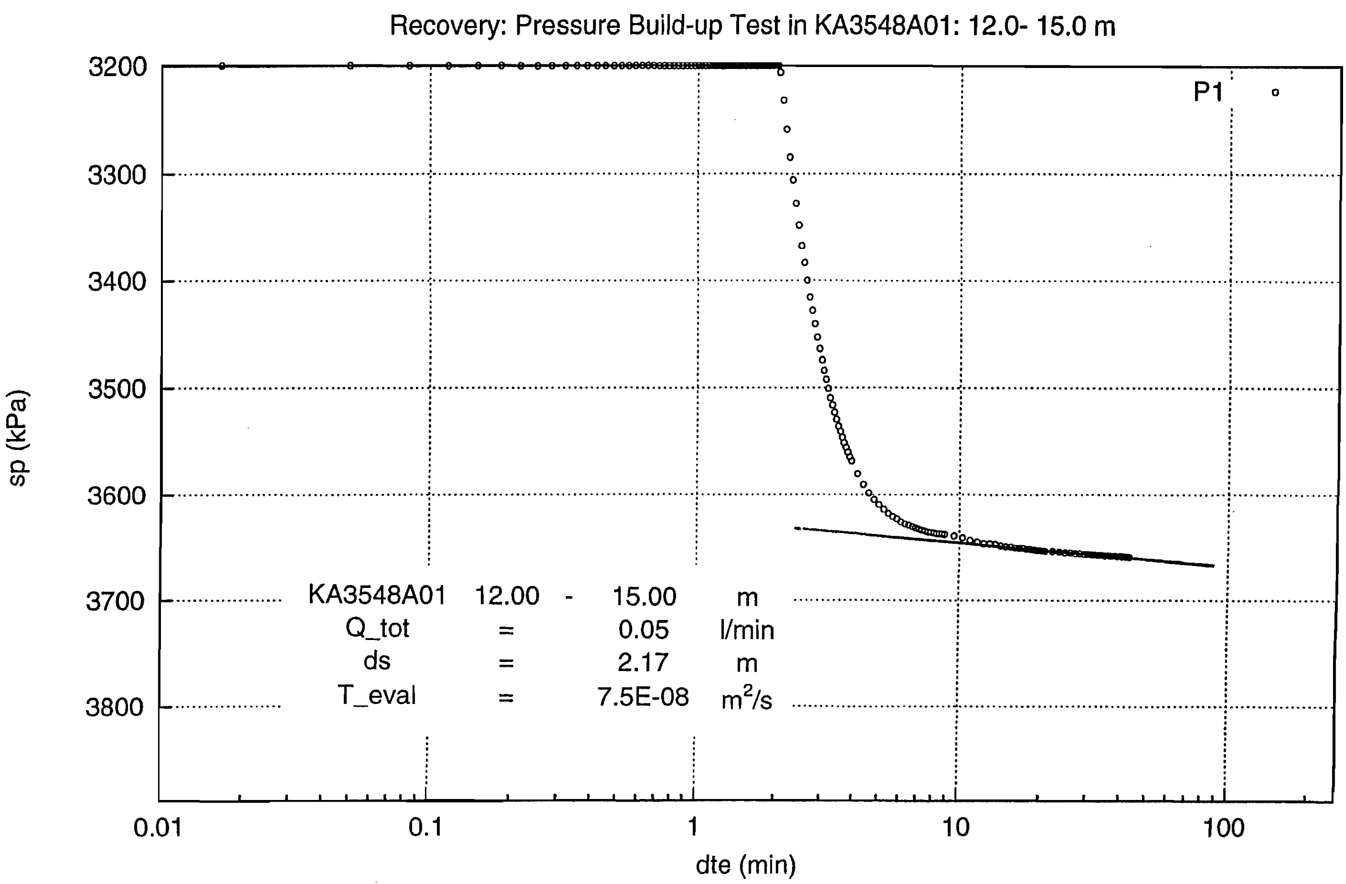
Recovery: Pressure Build-up Test in KA3548A01: 9.0- 10.0 m
P1
sp (kPa)
1000
100
10
0.01
0.1
1
10
100
dte (min)



Recovery: Pressure Build-up Test in KA3548A01: 9.0- 10.0 m
P1
sp (kPa)
0
1000
2000
3000
4000
5000
6000
KA3548A01 9.00 - 10.00 m
Q_tot = 1.91 l/min
ds = 54.30 m
T_eval = 1.1E-07 m²/s
0.01
0.1
1
10
100
dte (min)

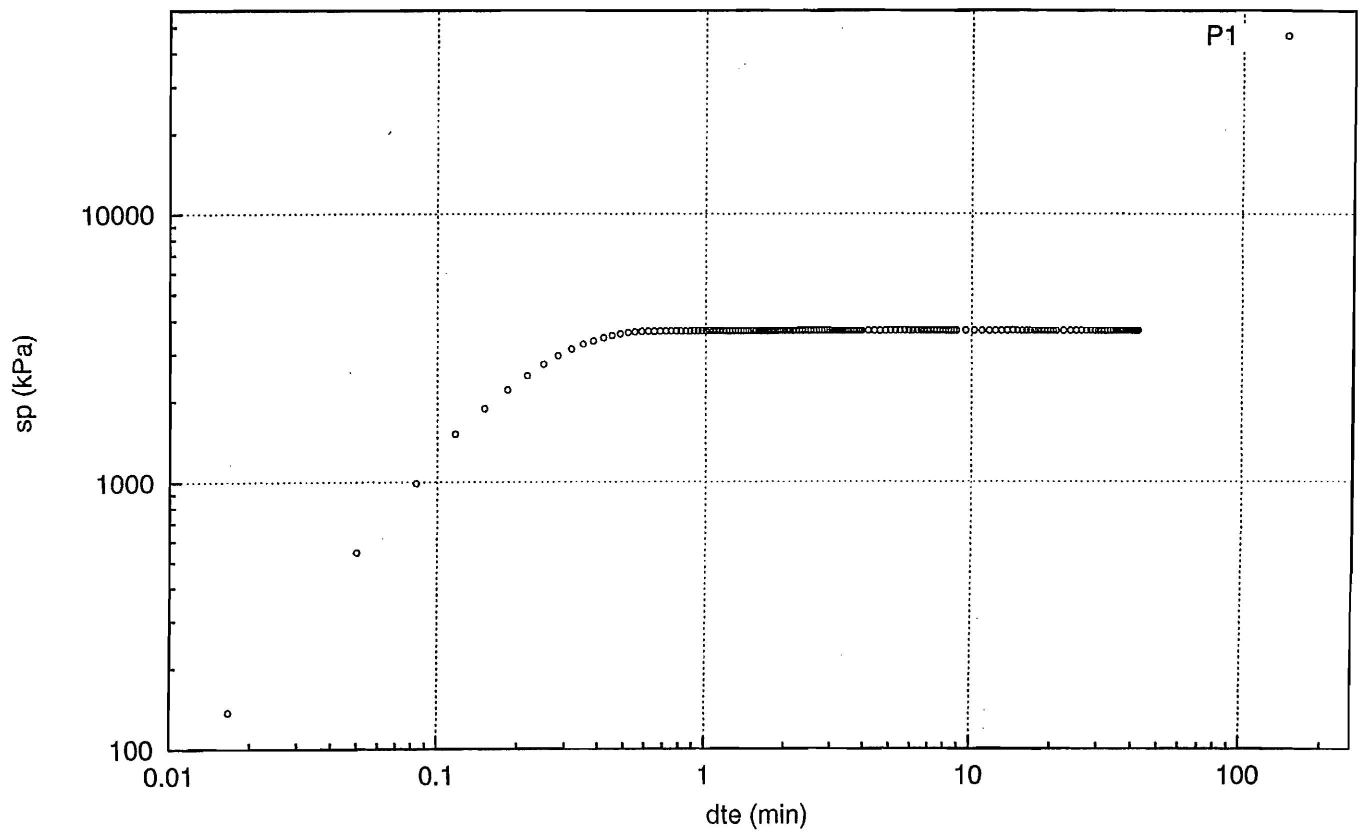


Recovery: Pressure Build-up Test in KA3548A01: 12.0- 15.0 m
P1
10000
1000
100
sp (kPa)
0.01
0.1
1
10
100
dte (min)

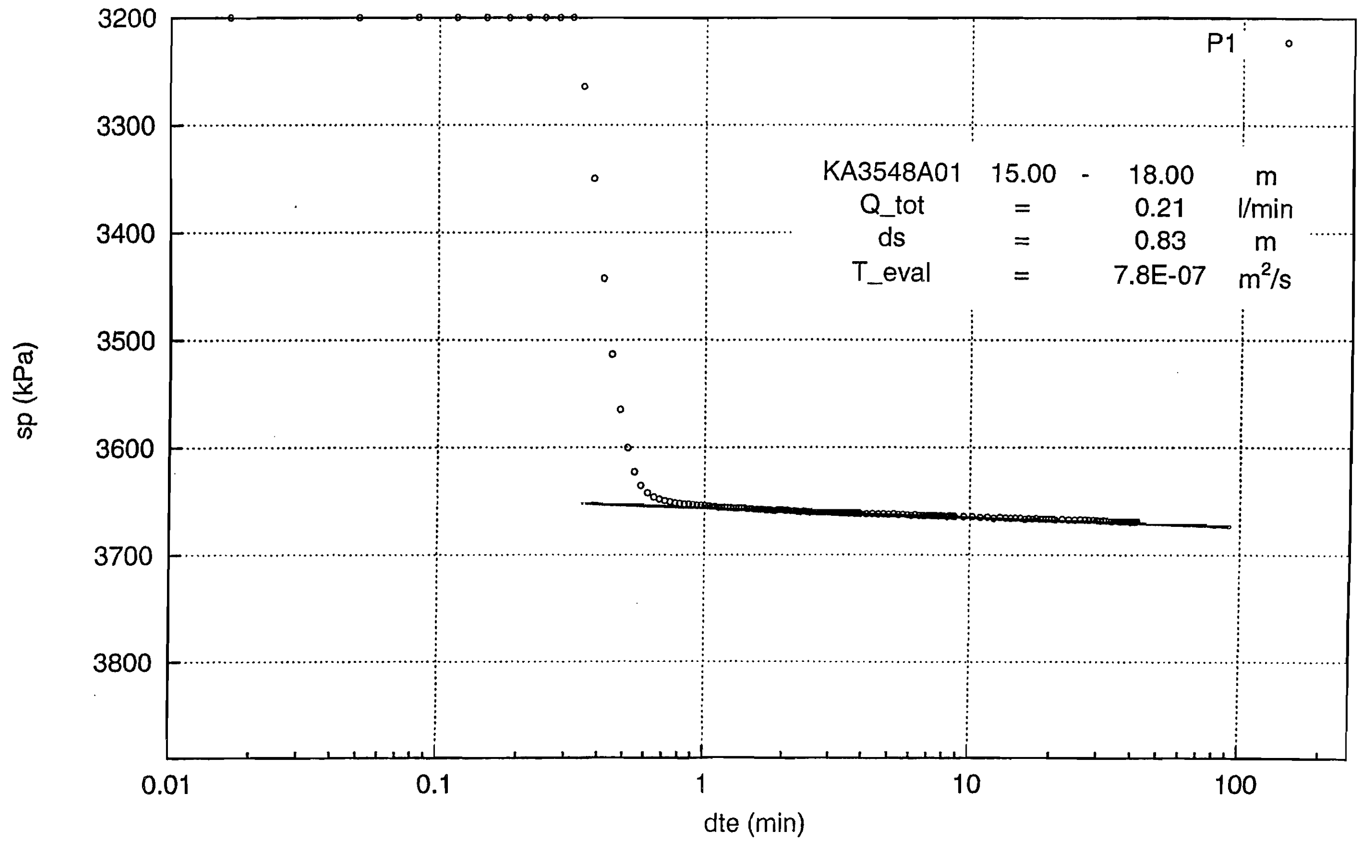


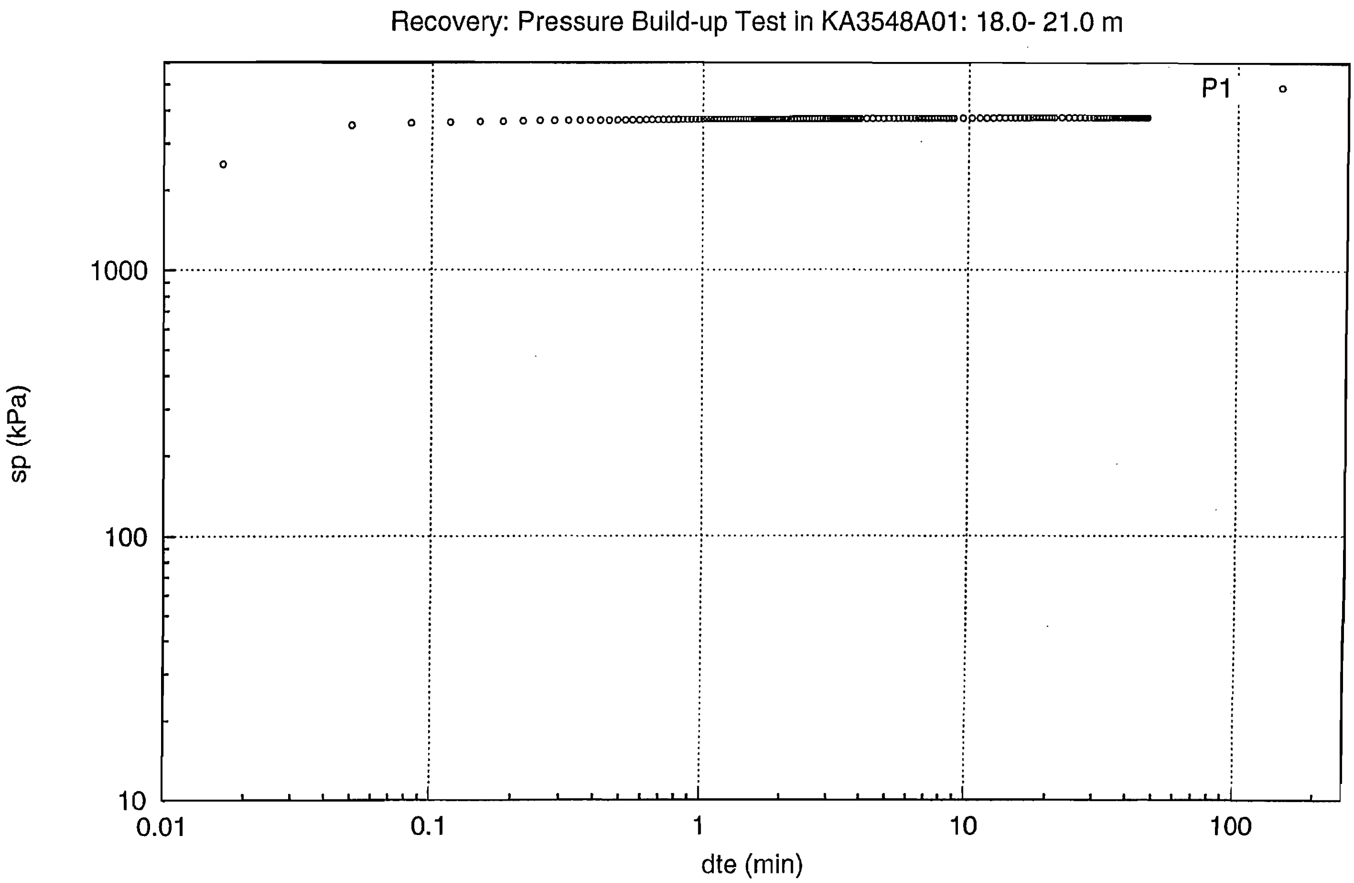
Recovery: Pressure Build-up Test in KA3548A01: 12.0- 15.0 m
P1
3200
3300
3400
3500
3600
3700
3800
sp (kPa)
KA3548A01 12.00 - 15.00 m
Q_tot = 0.05 l/min
ds = 2.17 m
T_eval = 7.5E-08 m²/s
0.01
0.1
1
10
100
dte (min)

Recovery:Pressure Build-up Test in KA3548A01: 15.0- 18.0 m

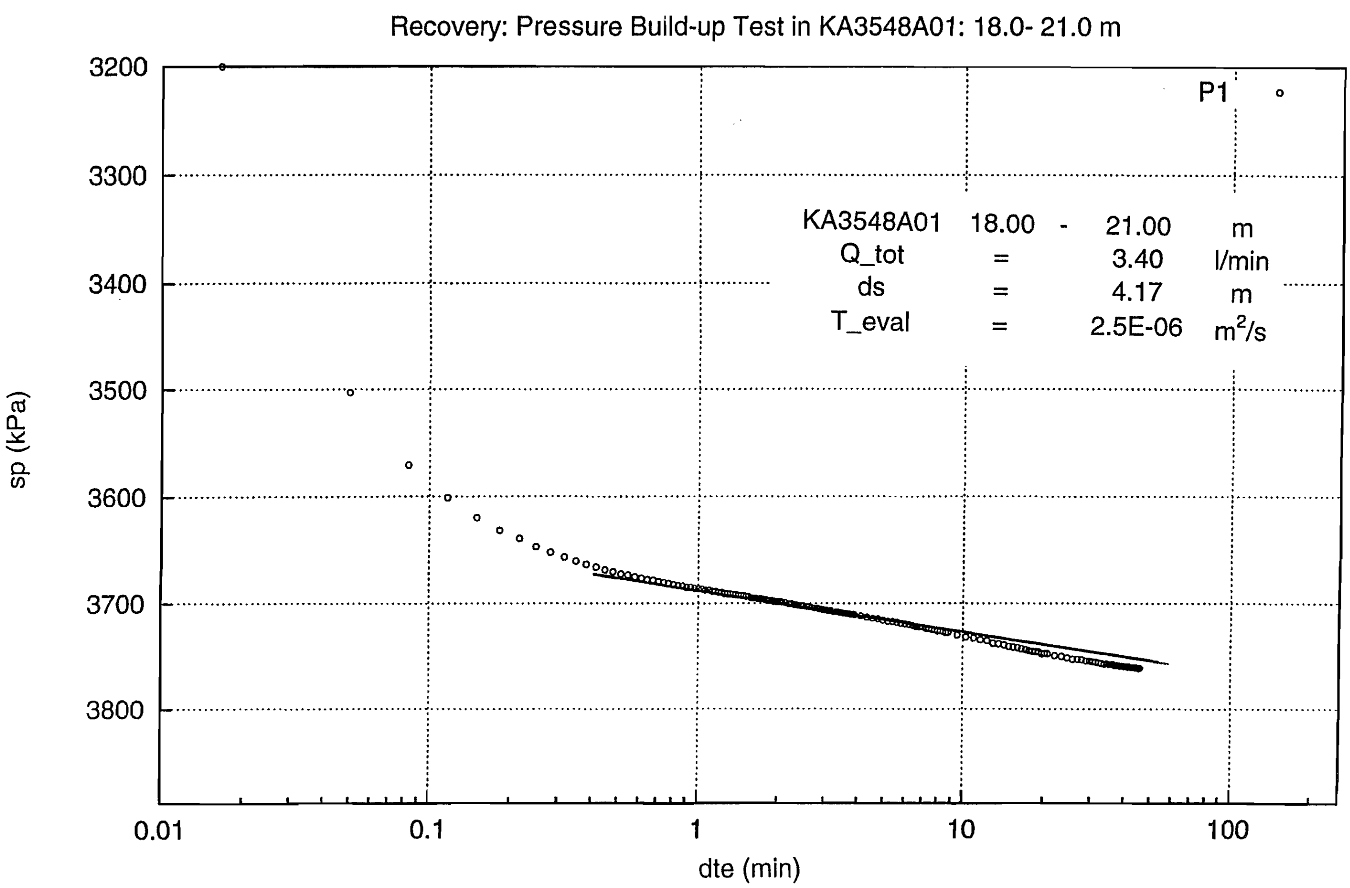


Recovery:Pressure Build-up Test in KA3548A01: 15.0- 18.0 m

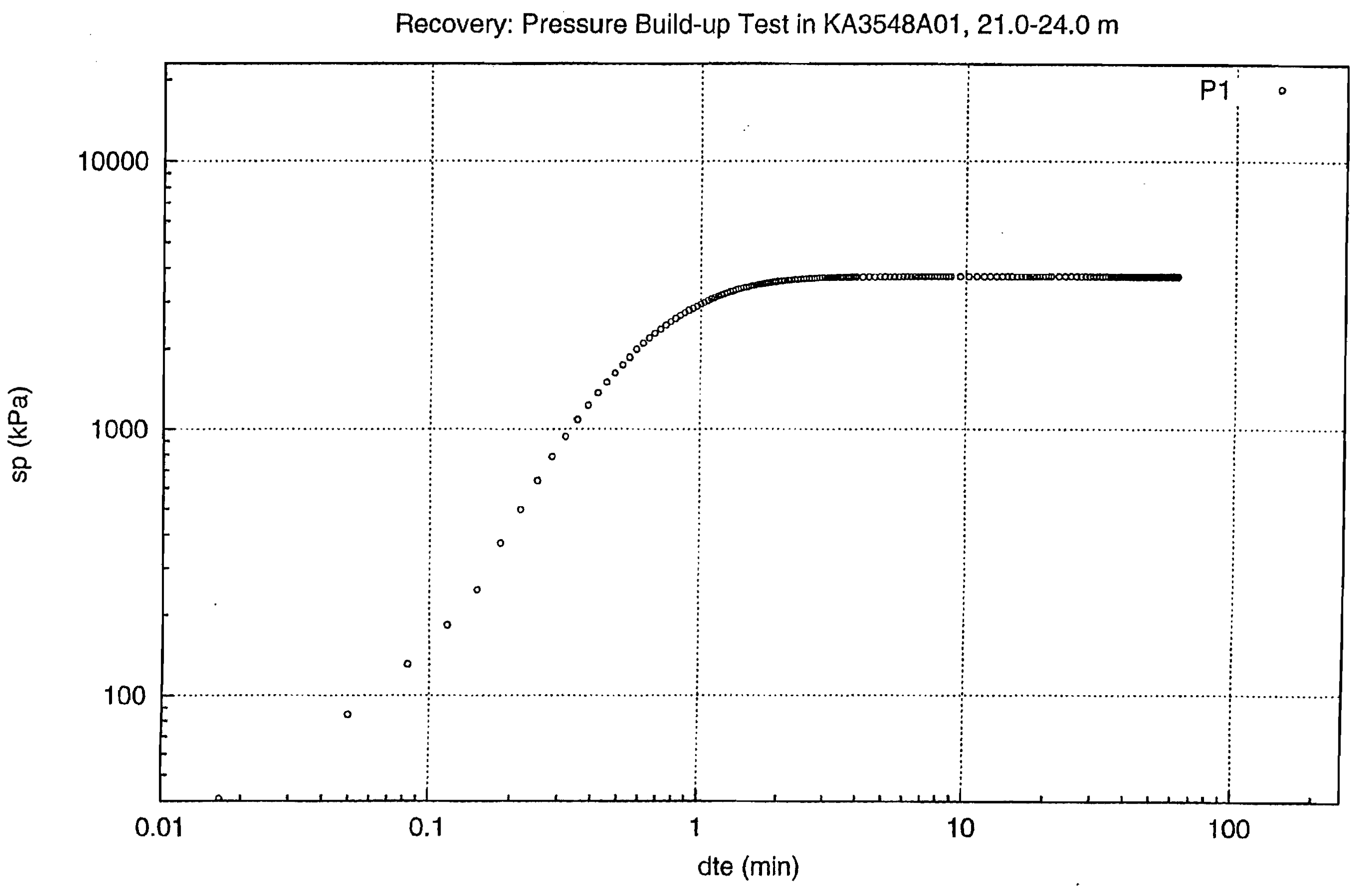




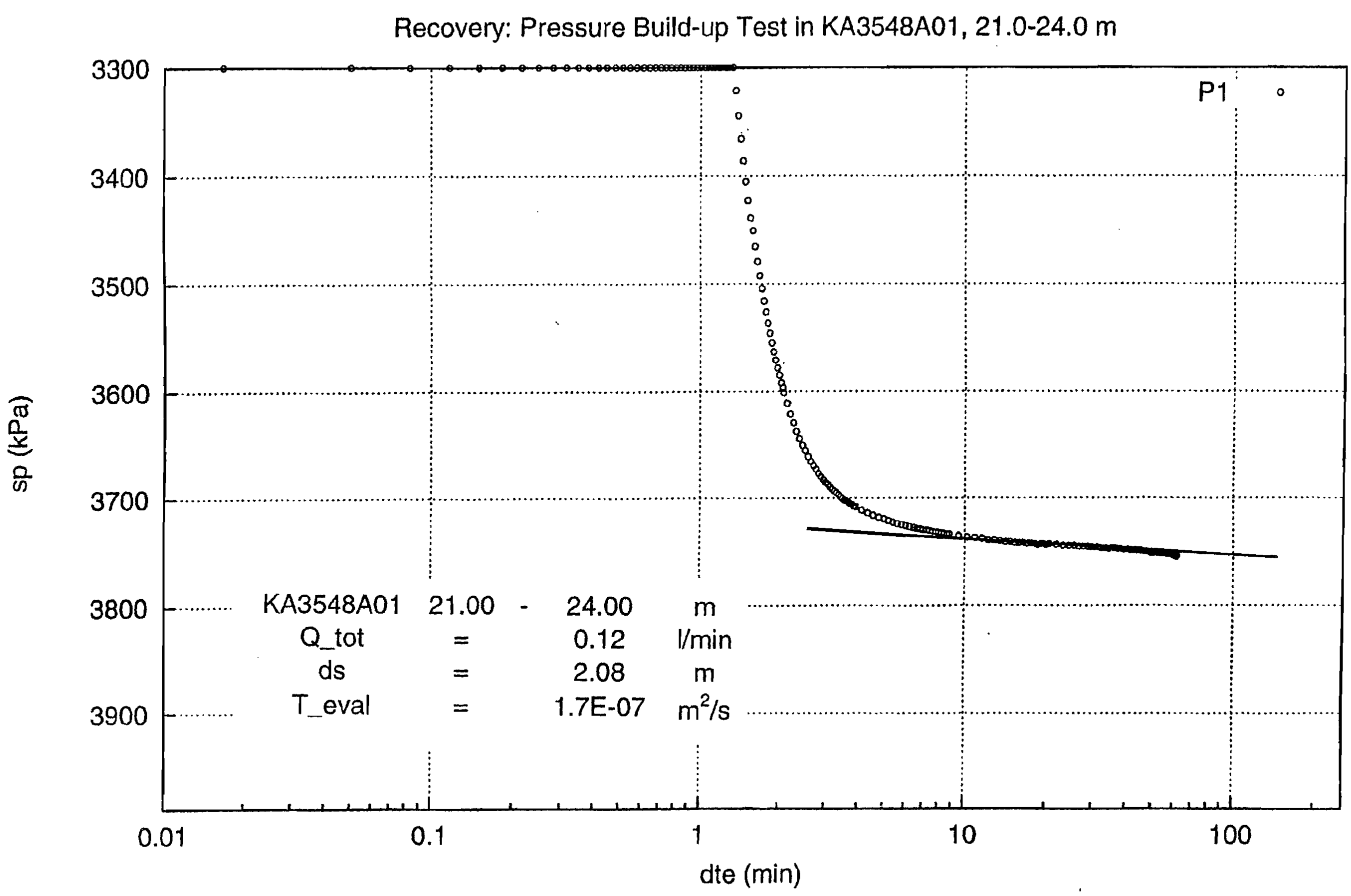
Recovery: Pressure Build-up Test in KA3548A01: 18.0- 21.0 m
P1
sp (kPa)
1000
100
10
0.01
0.1
1
10
100
dte (min)



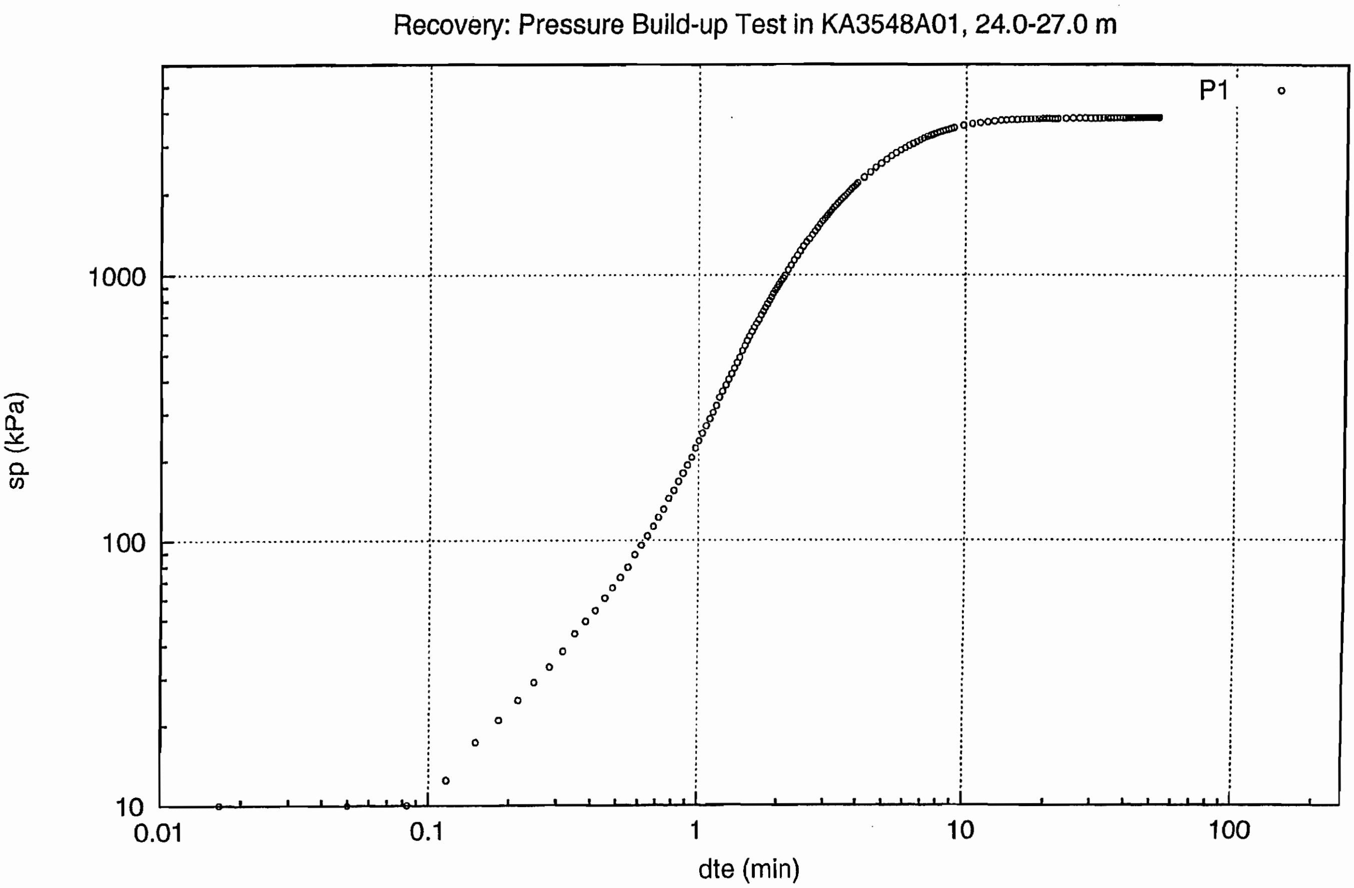
Recovery: Pressure Build-up Test in KA3548A01: 18.0- 21.0 m
P1
sp (kPa)
3200
3300
3400
3500
3600
3700
3800
KA3548A01 18.00 - 21.00 m
Q_tot = 3.40 l/min
ds = 4.17 m
T_eval = 2.5E-06 m²/s
0.01
0.1
1
10
100
dte (min)



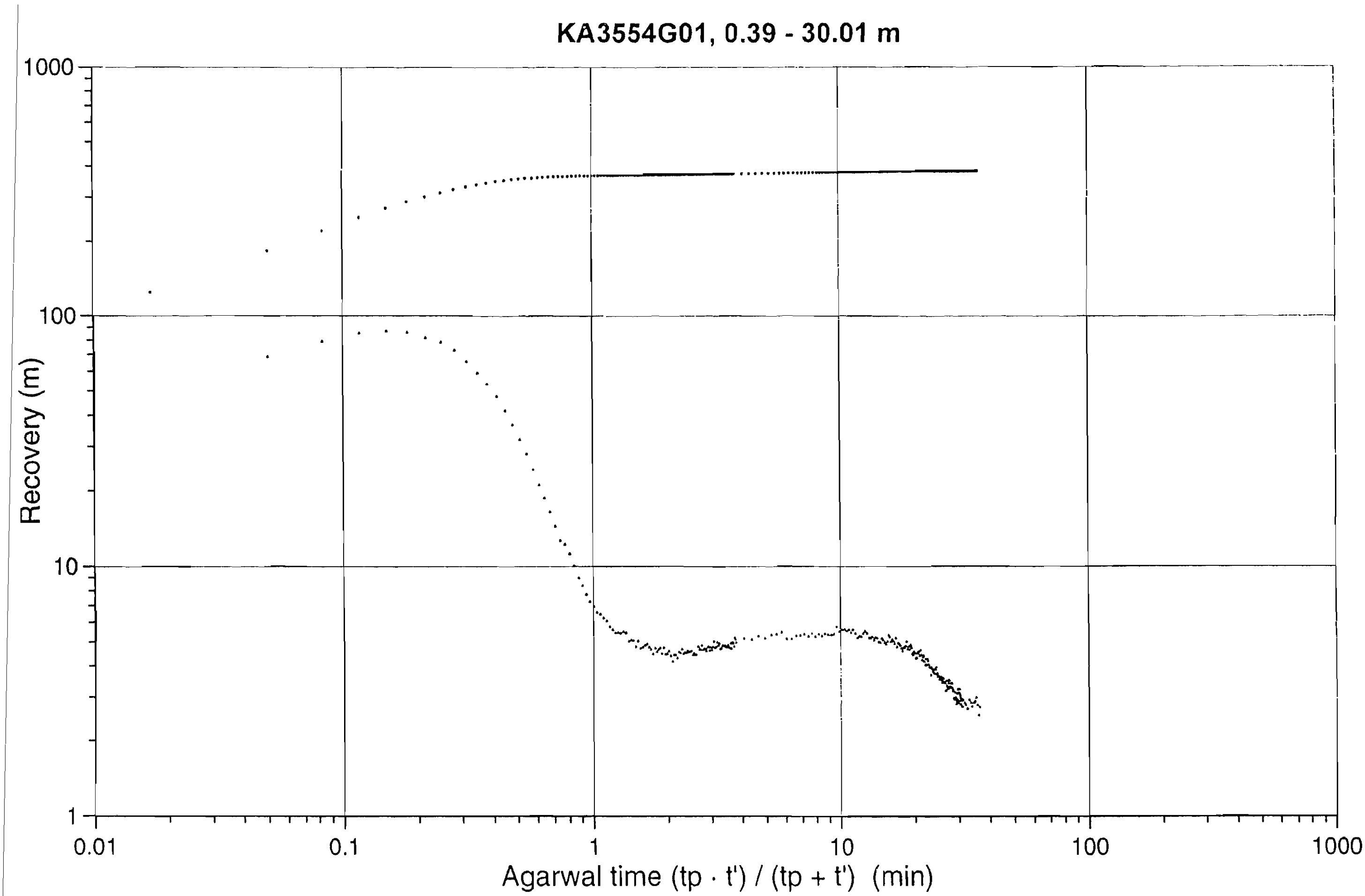
Recovery: Pressure Build-up Test in KA3548A01, 21.0-24.0 m
P1
10000
1000
100
sp (kPa)
0.01
0.1
1
10
100
dte (min)



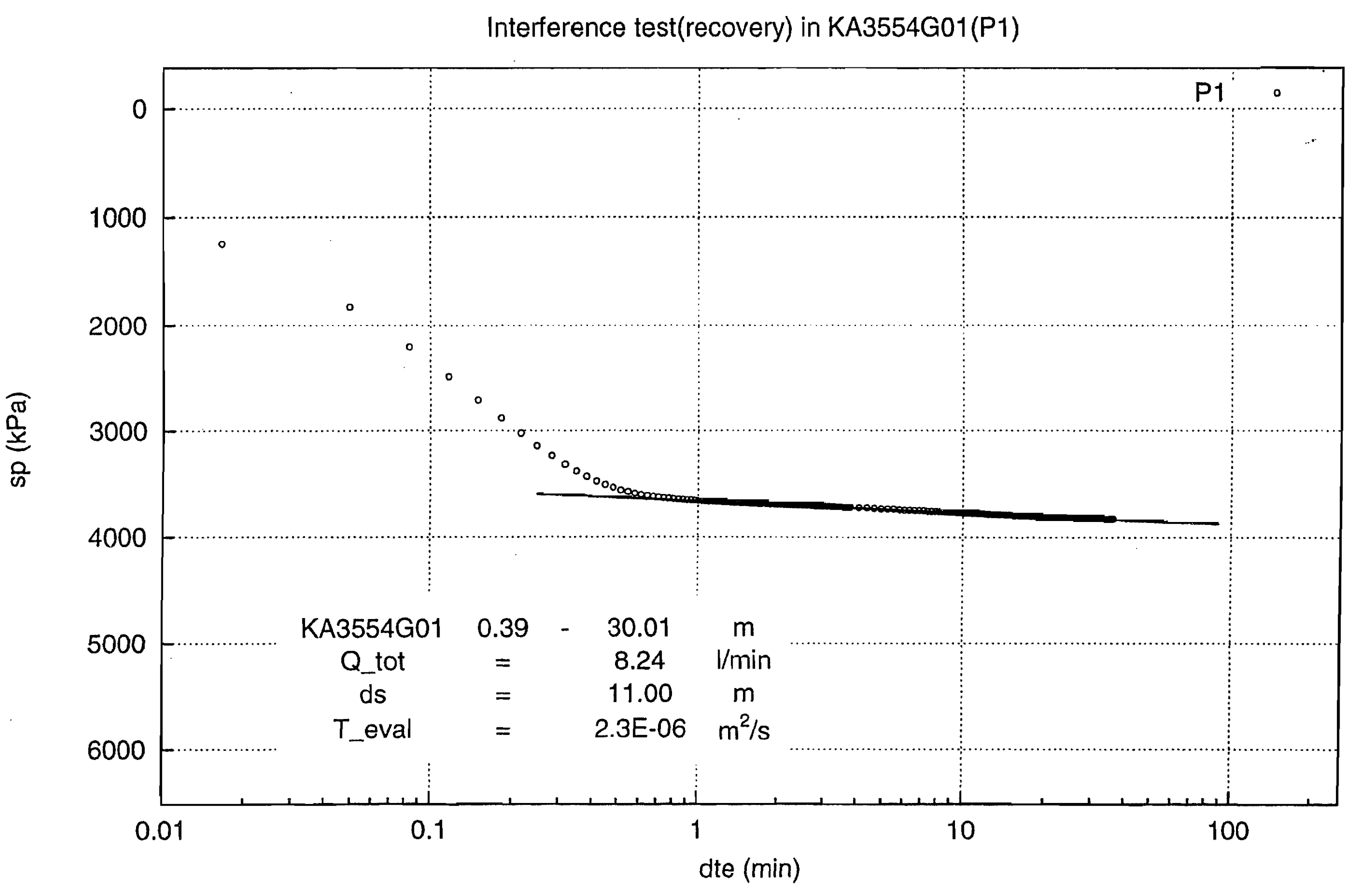
Recovery: Pressure Build-up Test in KA3548A01, 21.0-24.0 m
P1
3300
3400
3500
3600
3700
3800
3900
sp (kPa)
KA3548A01 21.00 - 24.00 m
Q_tot = 0.12 l/min
ds = 2.08 m
T_eval = 1.7E-07 m²/s
0.01
0.1
1
10
100
dte (min)



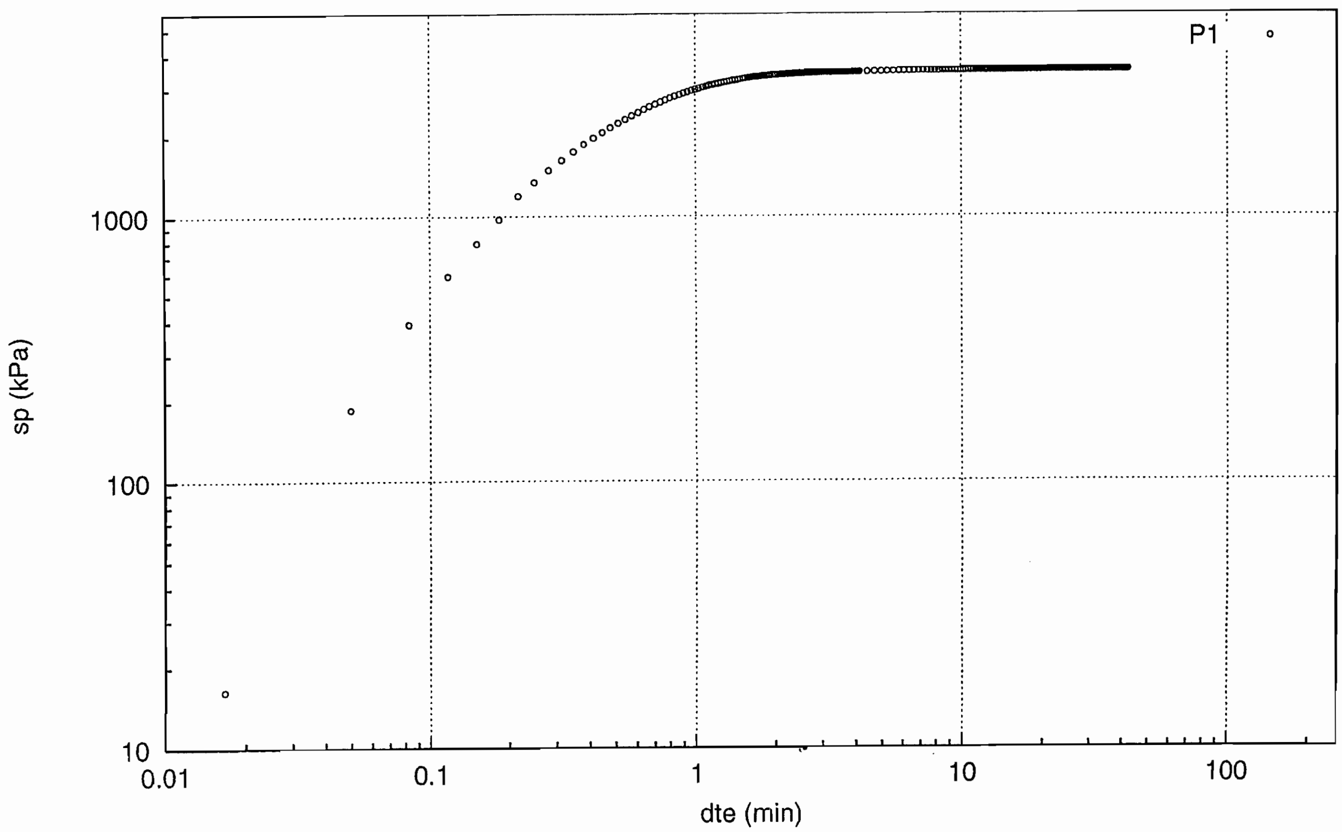
KA3548A01	24.00	-	27.00	m
Q_tot	=		0.02	l/min
ds	=		-	m
T_eval	=		-	m^2/s



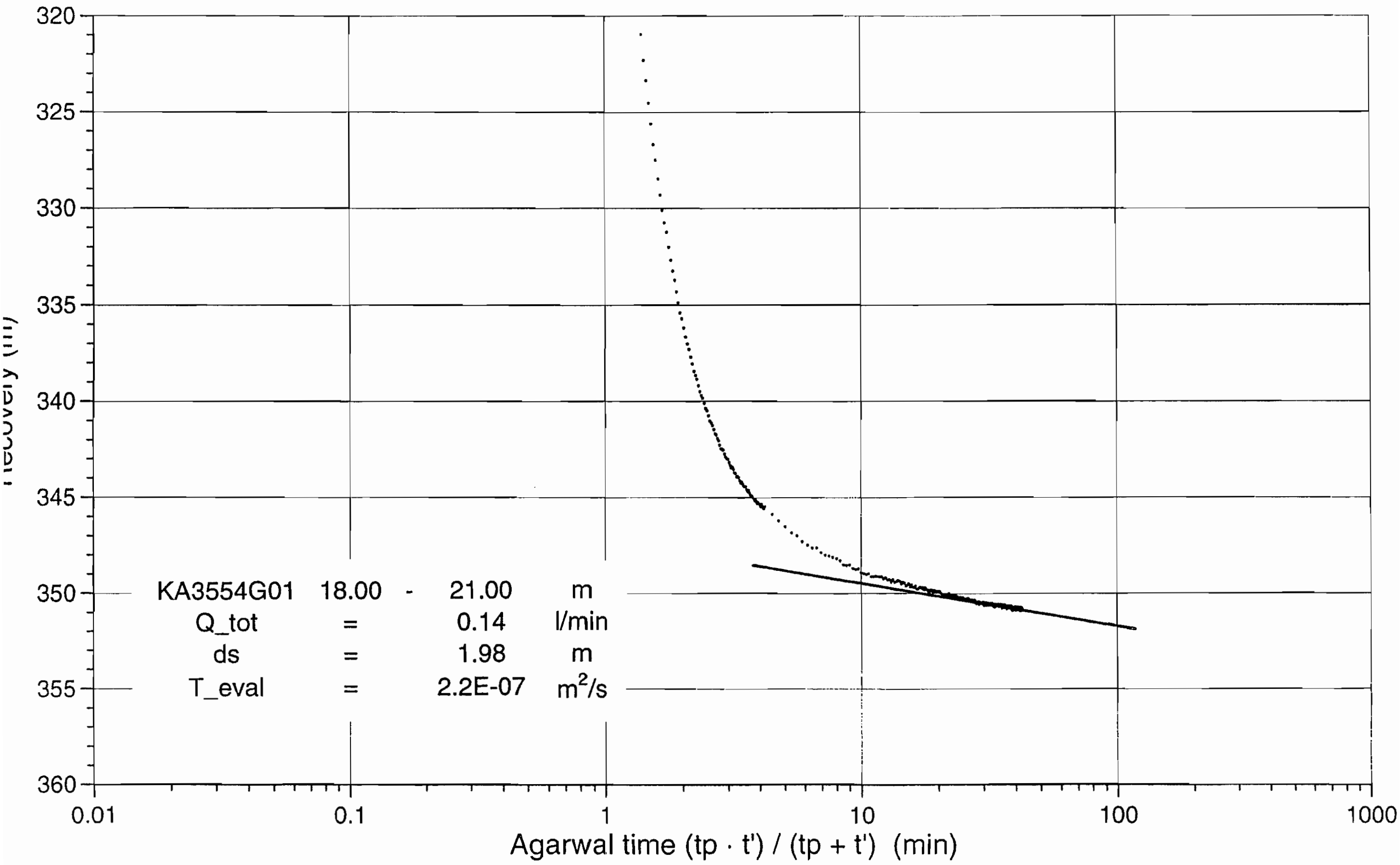
/13080198/DATA/bholeb03/utv_03/10pb3554.grf 10/01/98



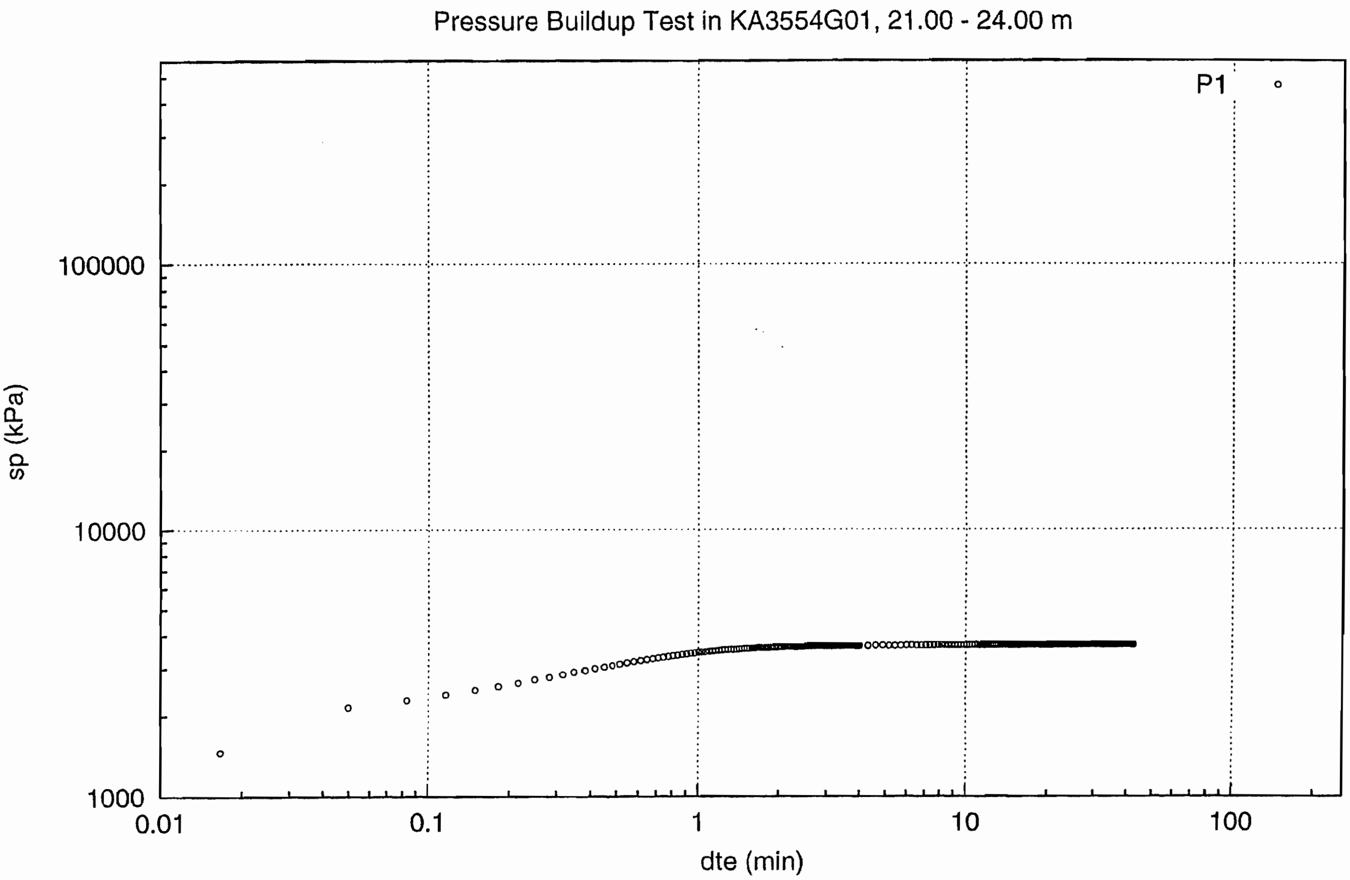
Pressure Buildup Test in KA3554G01, 18.00 - 21.00 m

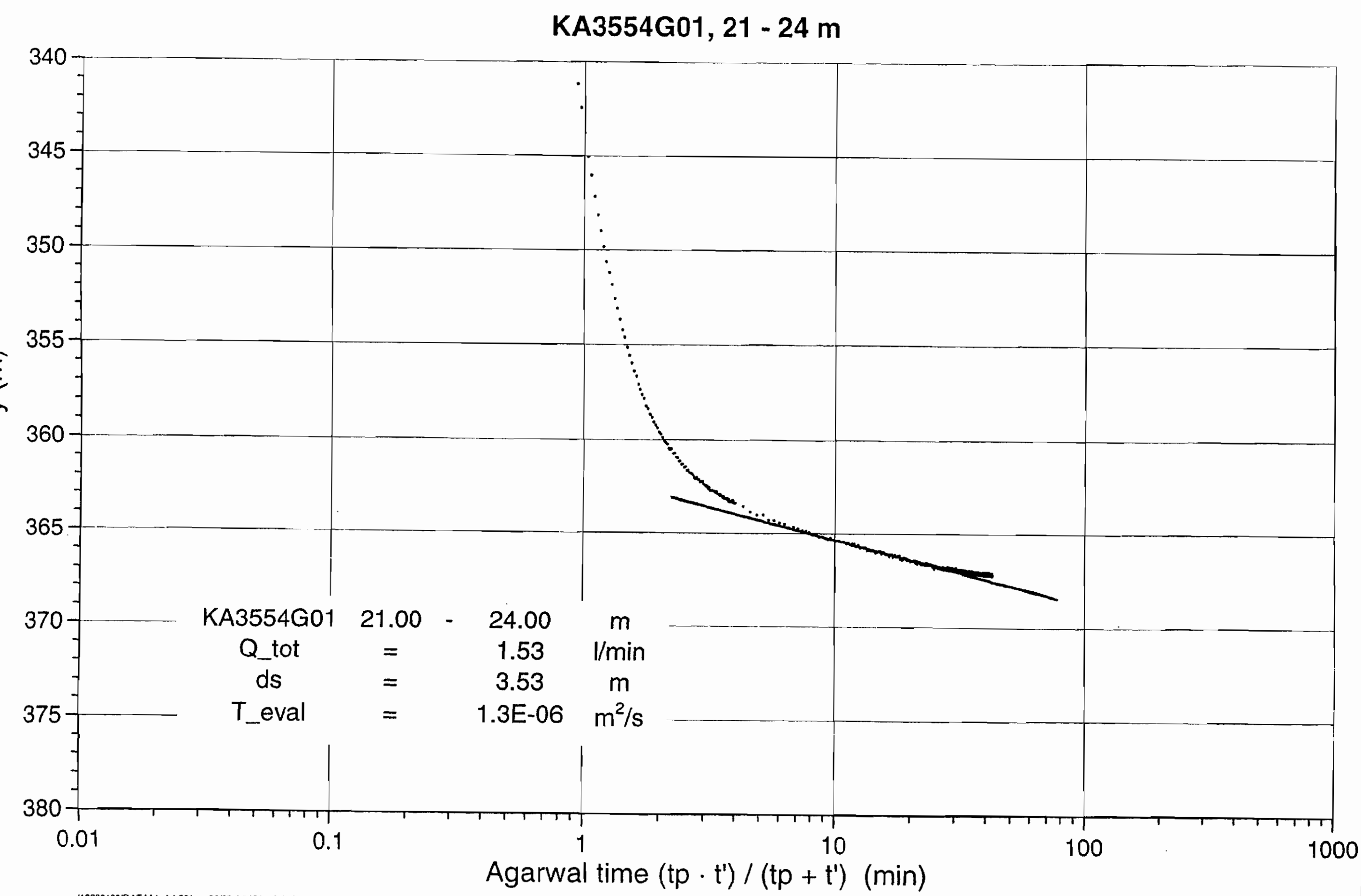


KA3554G01, 18 - 21 m



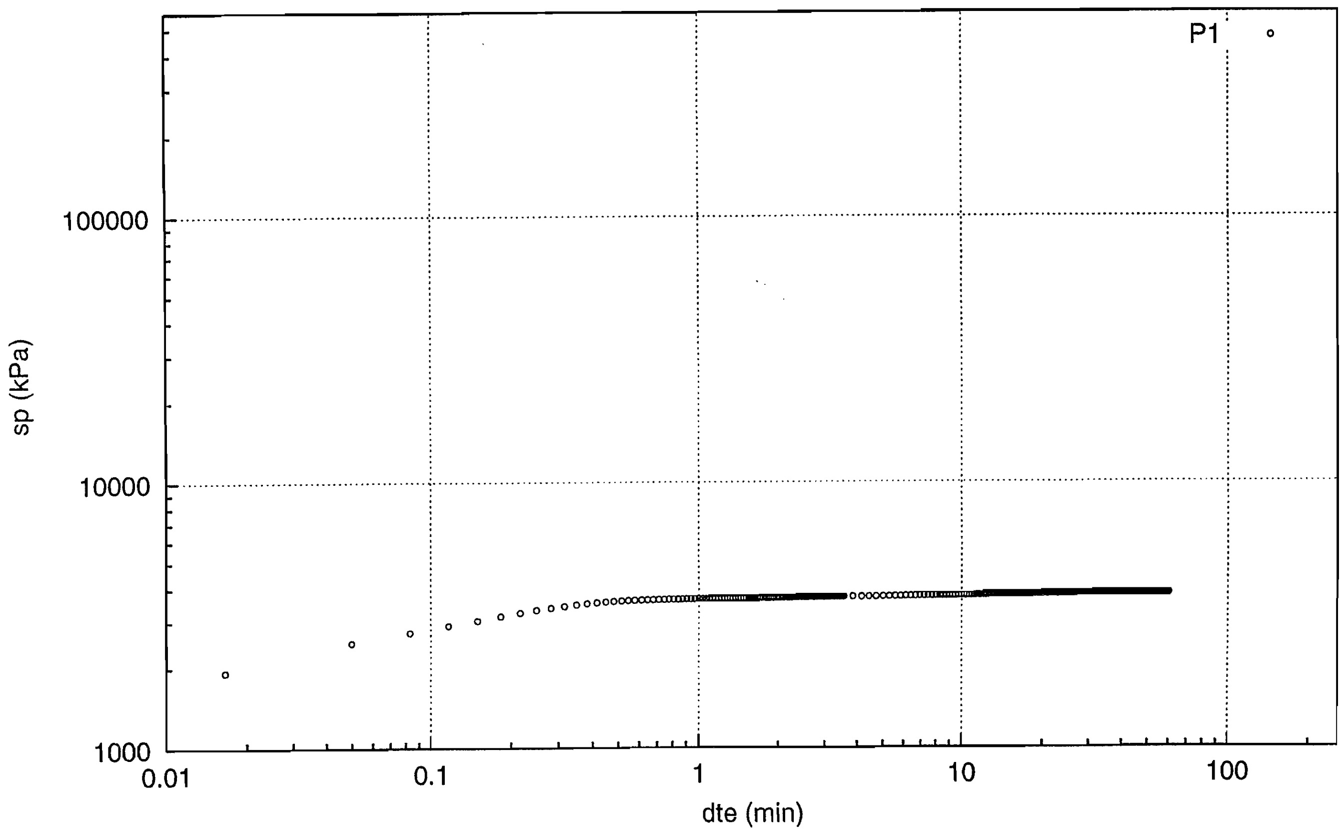
/13080198/DATA/bholeb03/utv_03/38pb3554.grf 04/22/99



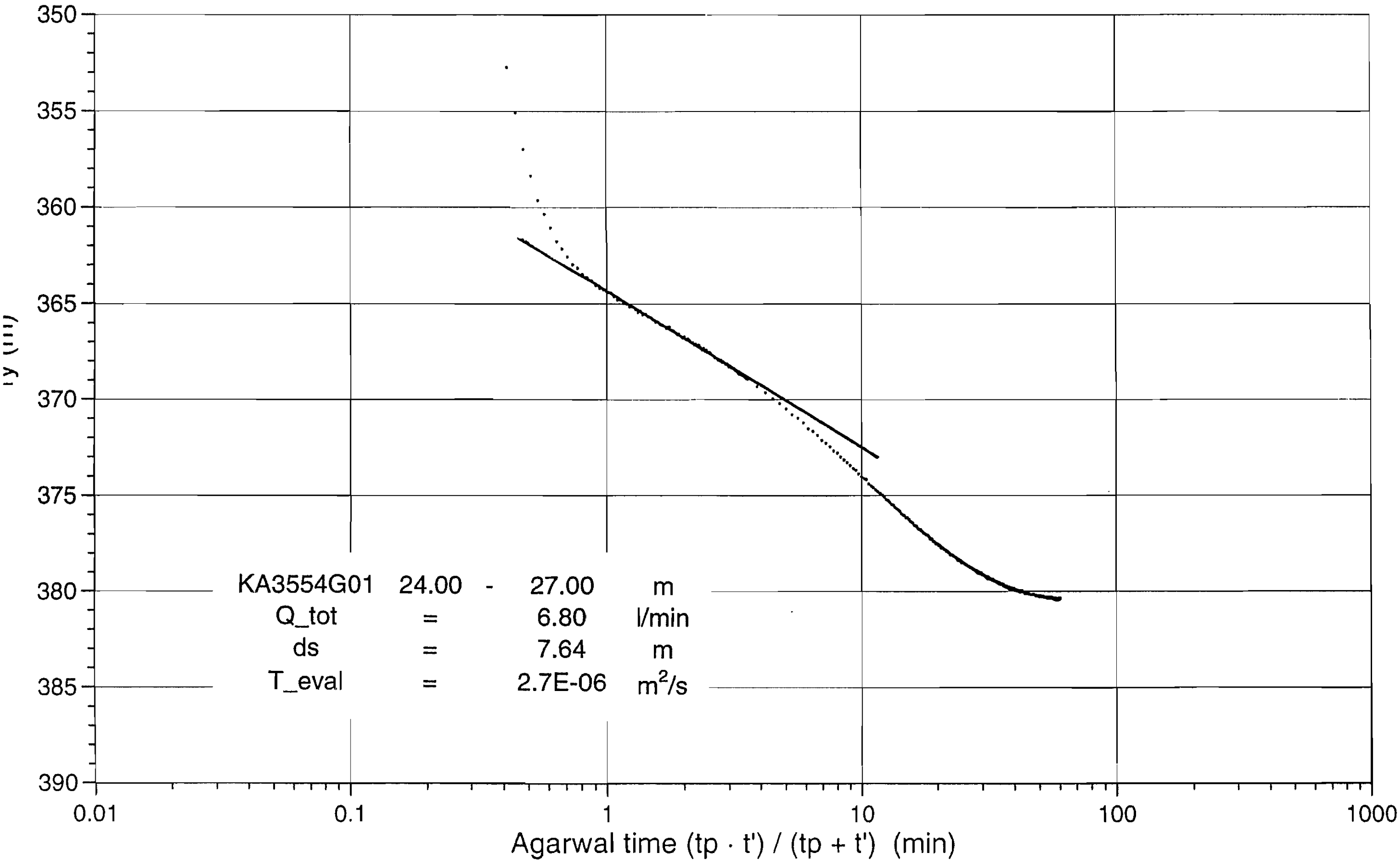


/13080198/DATA/bholeb03/utv_03/39pb3554.grf 04/22/99

Pressure Buildup Test in KA3554G01, 24.00 - 27.00 m

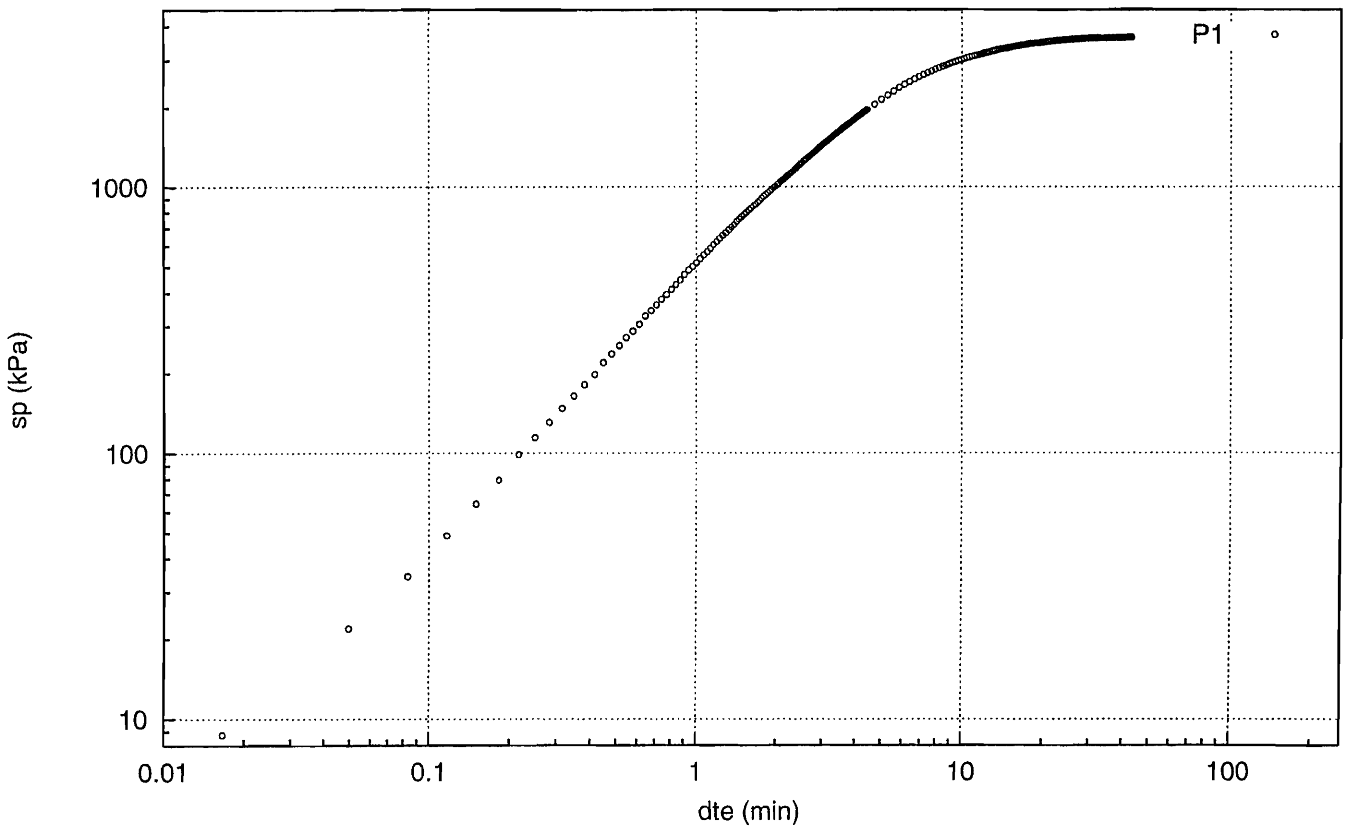


KA3554G01, 24 - 27 m

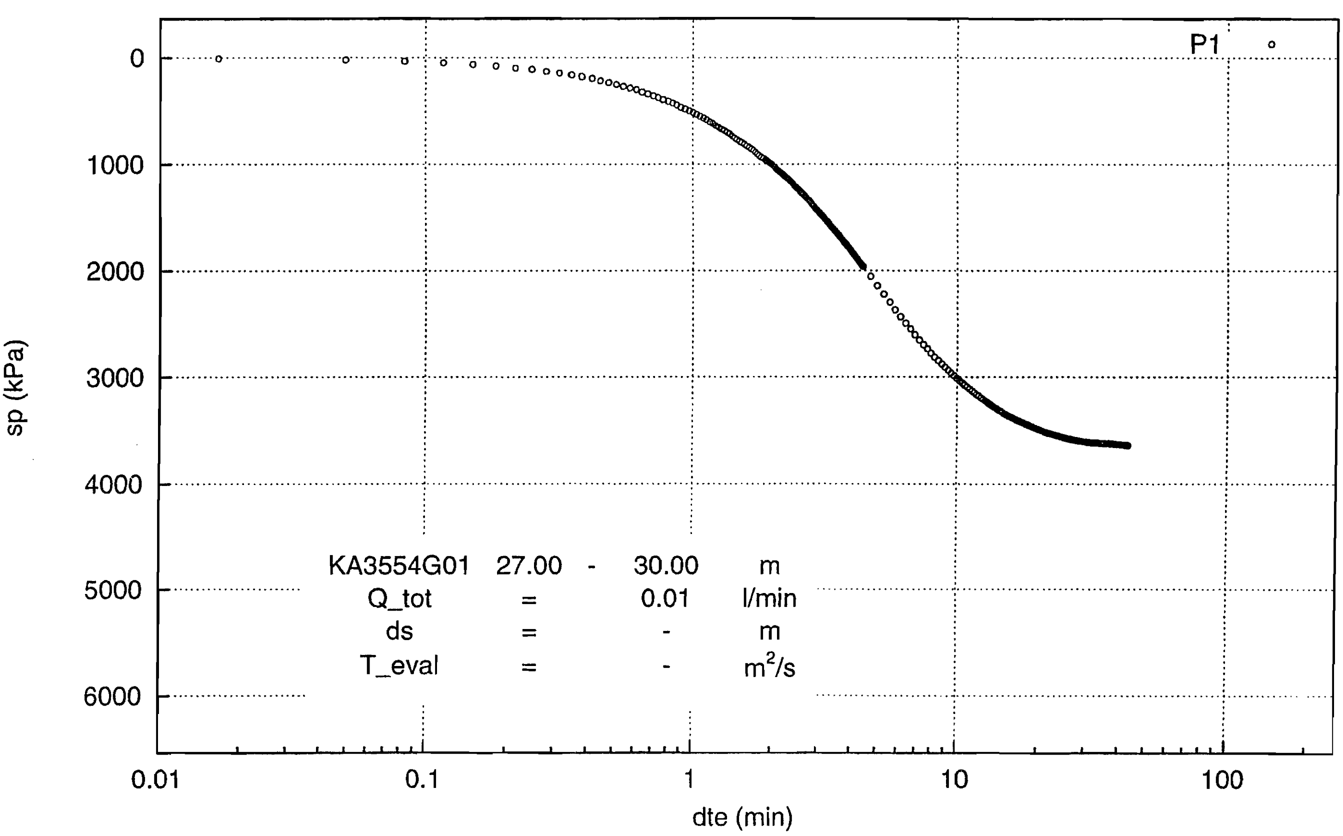


/13080198/DATA/bholeb03/utv_03/40pb3554.grf 04/22/99

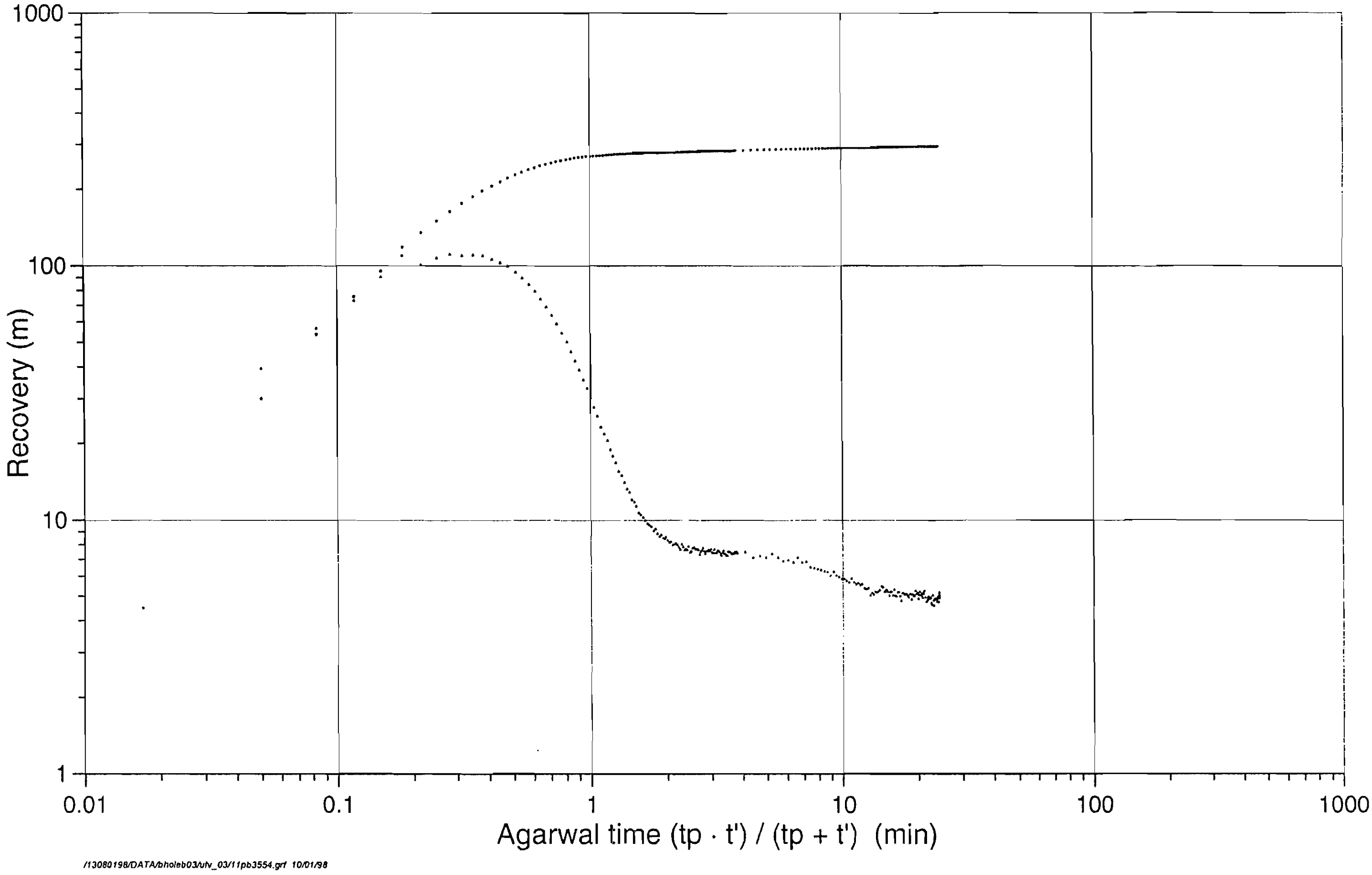
Pressure Buildup Test in KA3554G01, 27.00 - 30.00 m



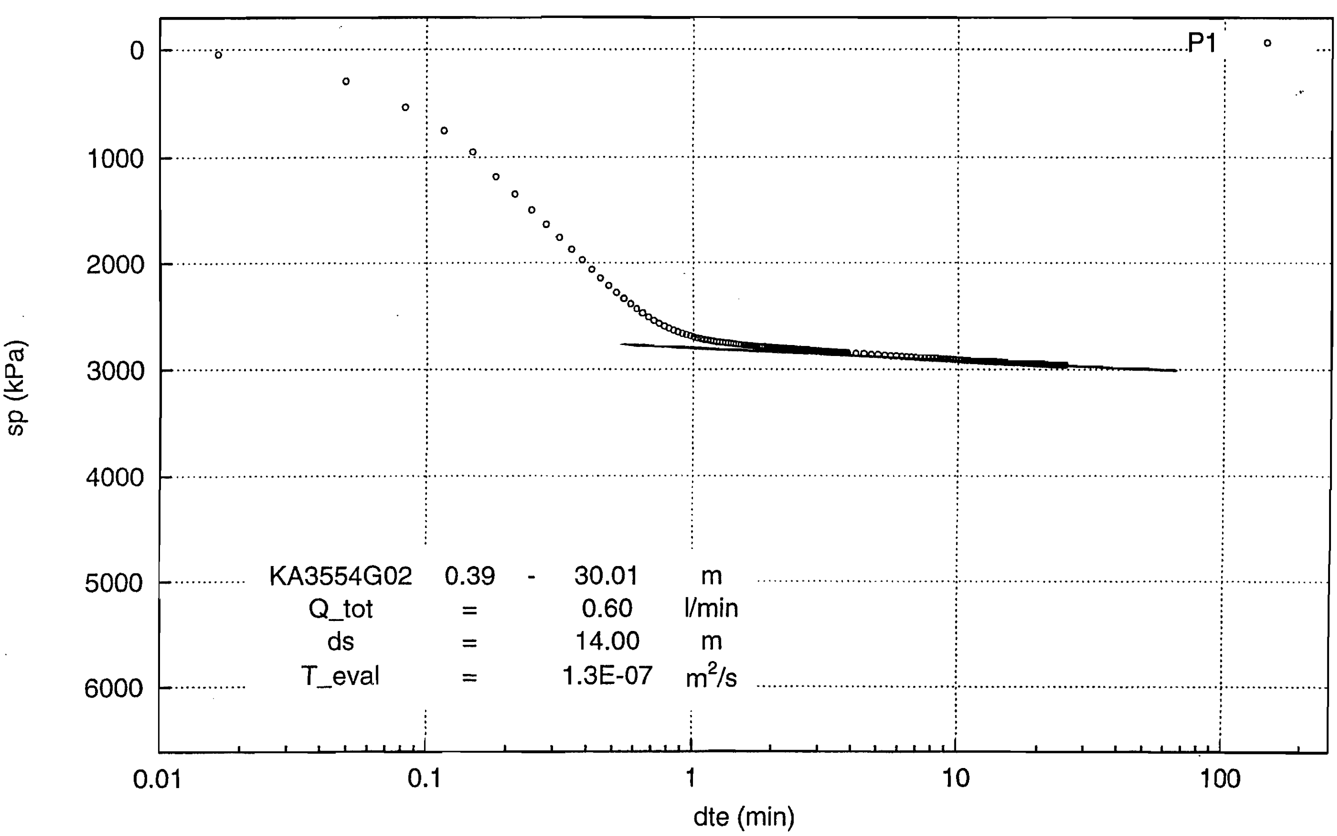
Pressure Buildup Test in KA3554G01, 27.00 - 30.00 m

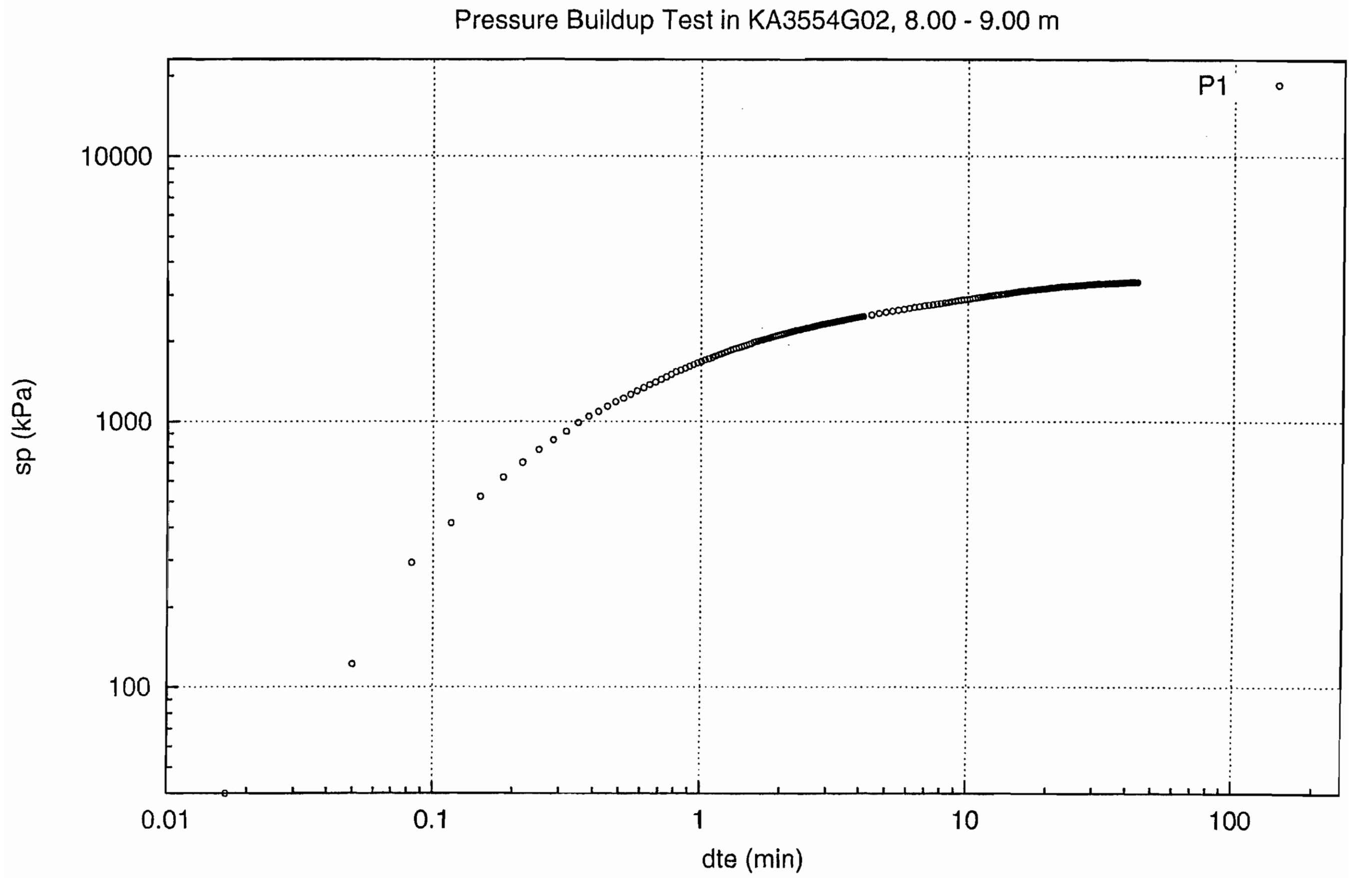


KA3554G02, 0.39 - 30.01 m

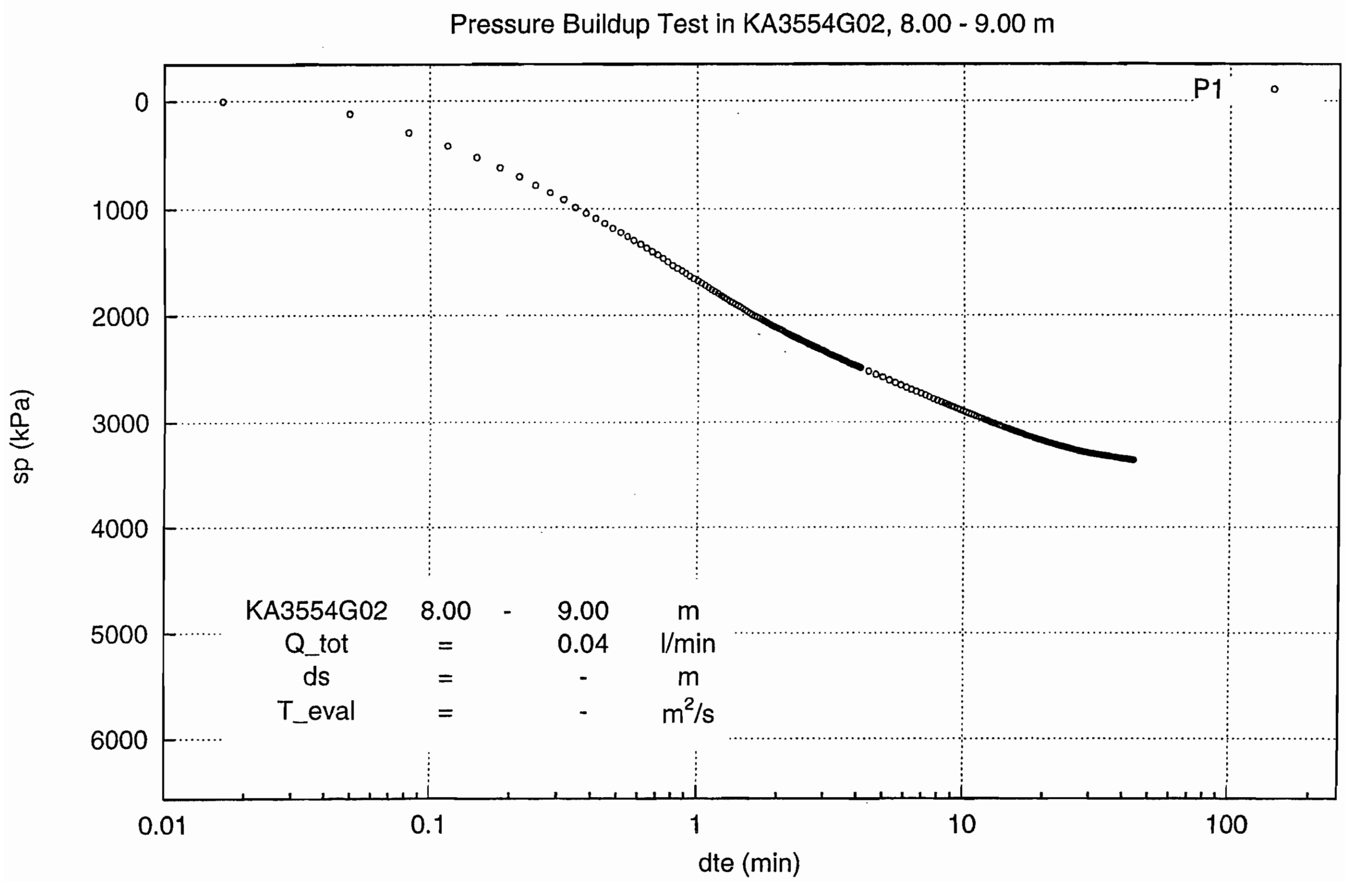


Interference test(recovery) in KA3554G02(P1)

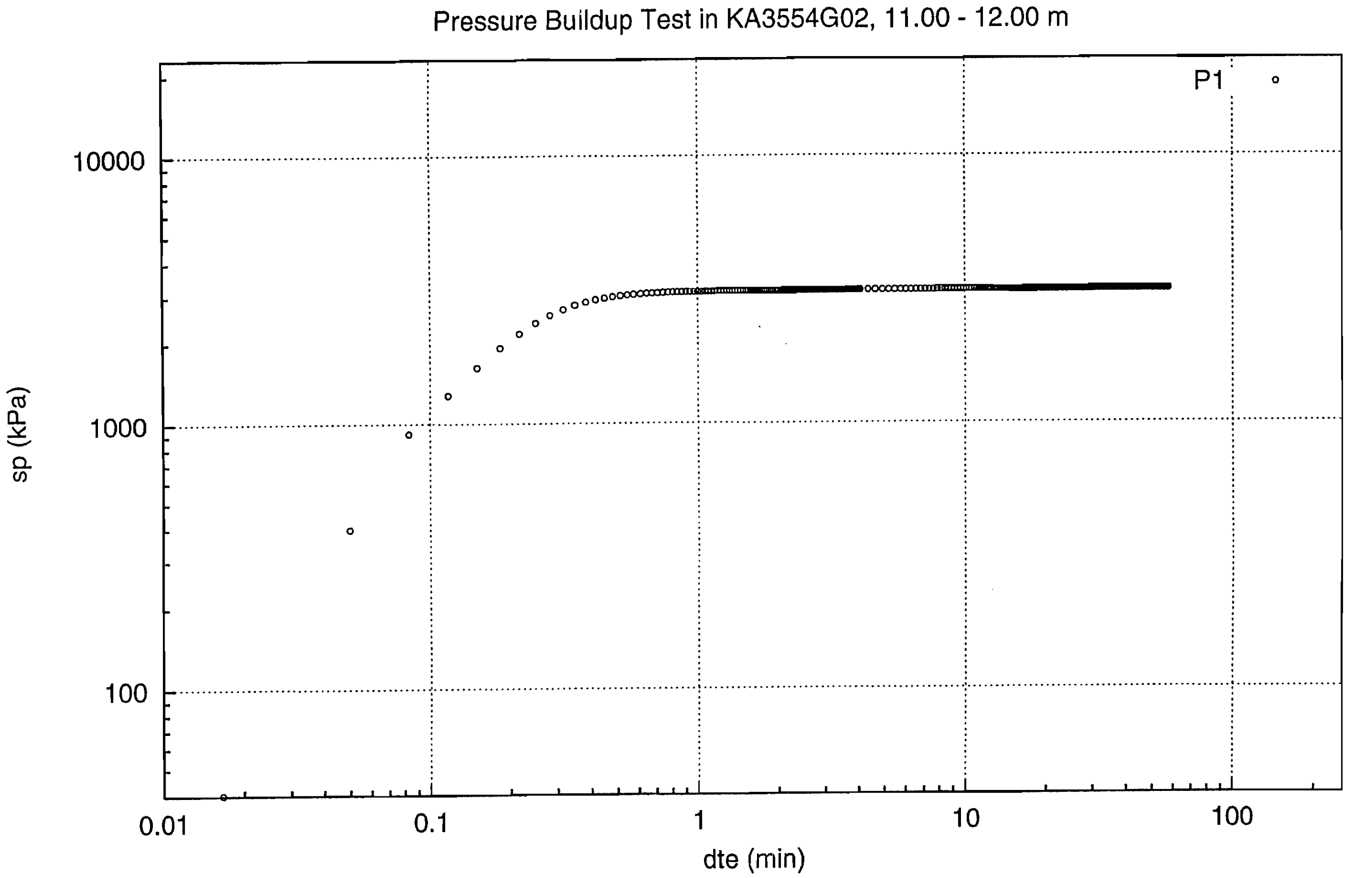


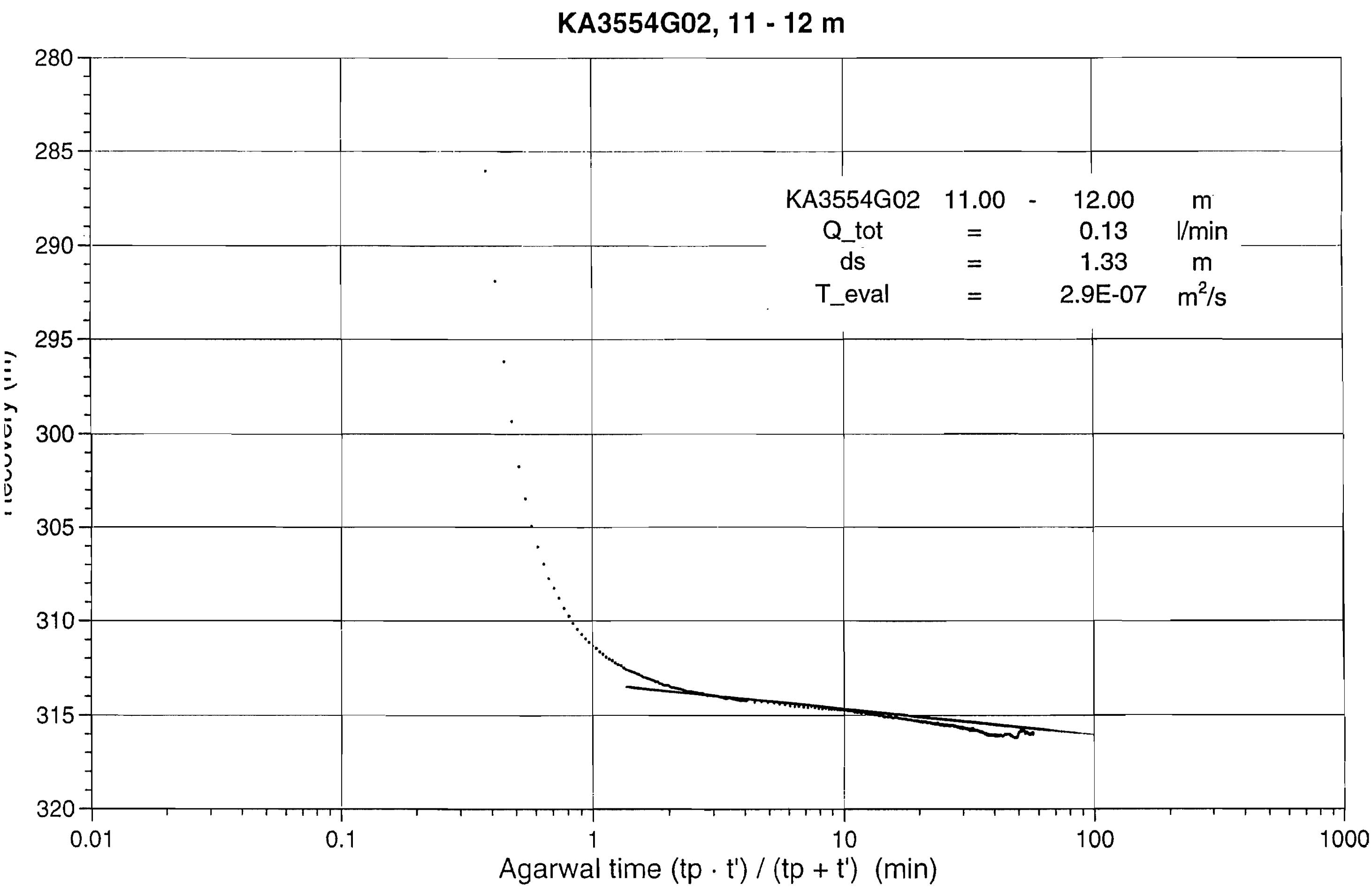


Pressure Buildup Test in KA3554G02, 8.00 - 9.00 m
P1
10000
1000
100
sp (kPa)
0.01
0.1
1
10
100
dte (min)

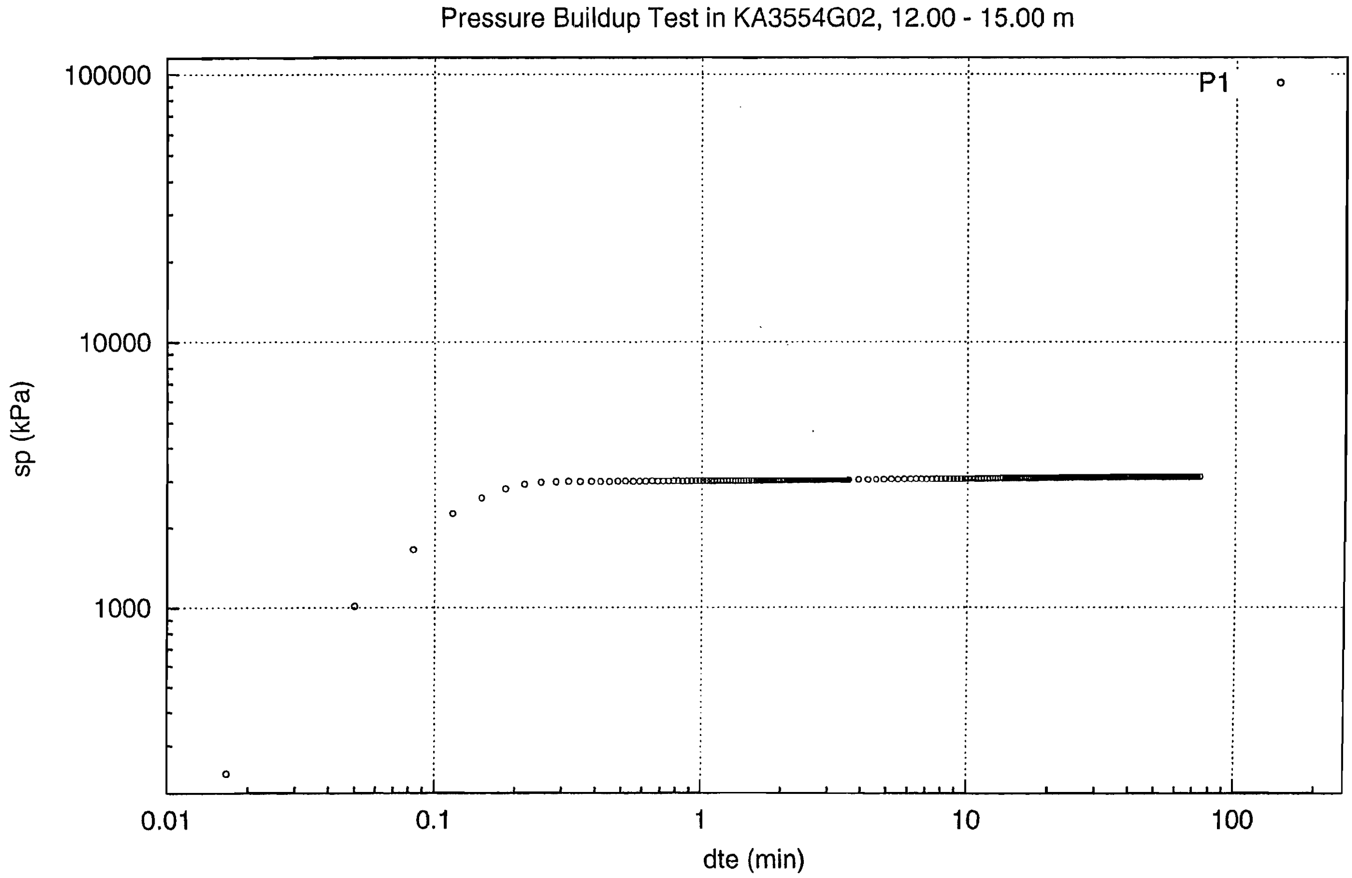


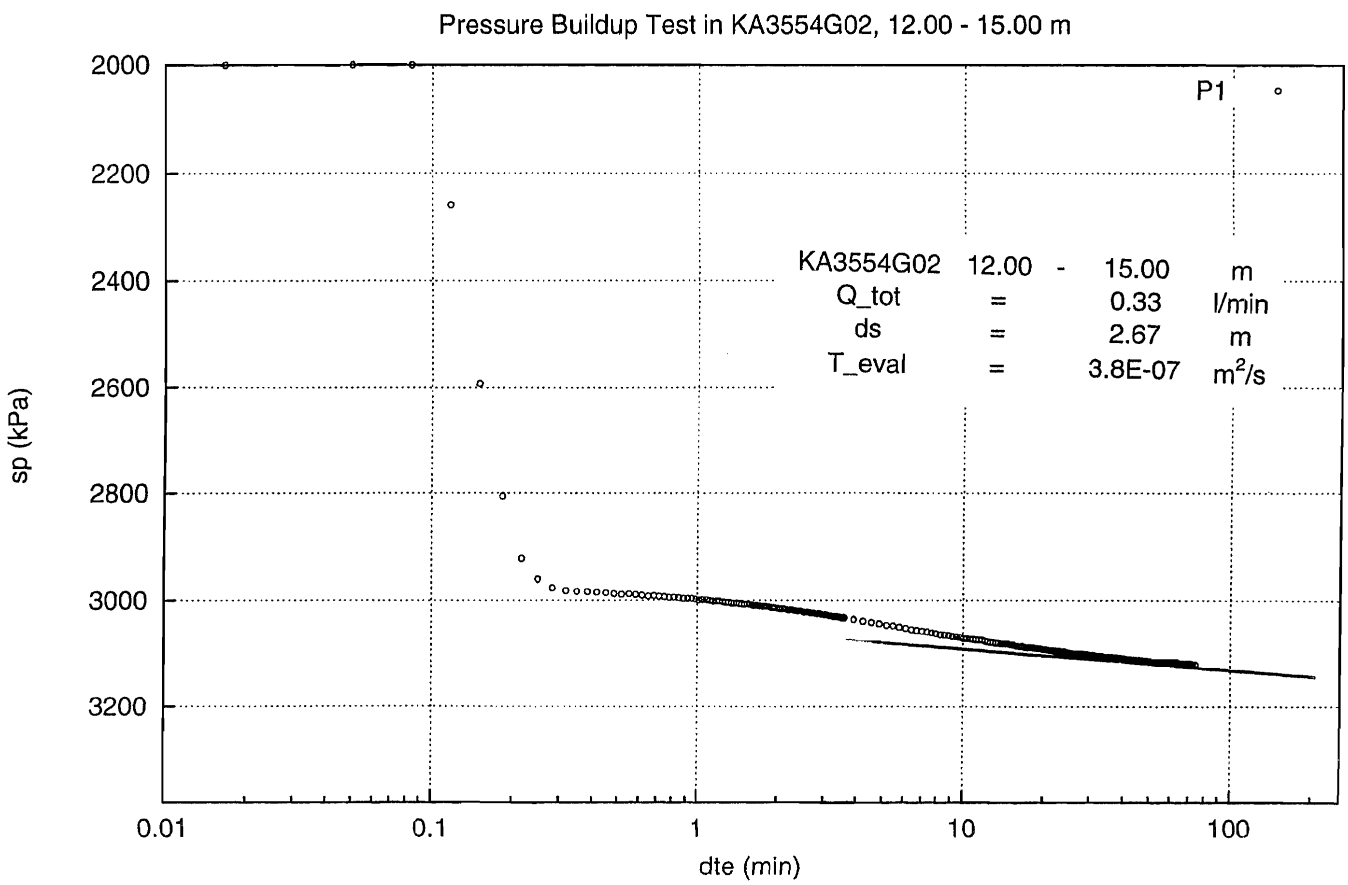
Pressure Buildup Test in KA3554G02, 8.00 - 9.00 m
P1
0
1000
2000
3000
4000
5000
6000
sp (kPa)
KA3554G02 8.00 - 9.00 m
Q_tot = 0.04 l/min
ds = - m
T_eval = - m²/s
0.01
0.1
1
10
100
dte (min)

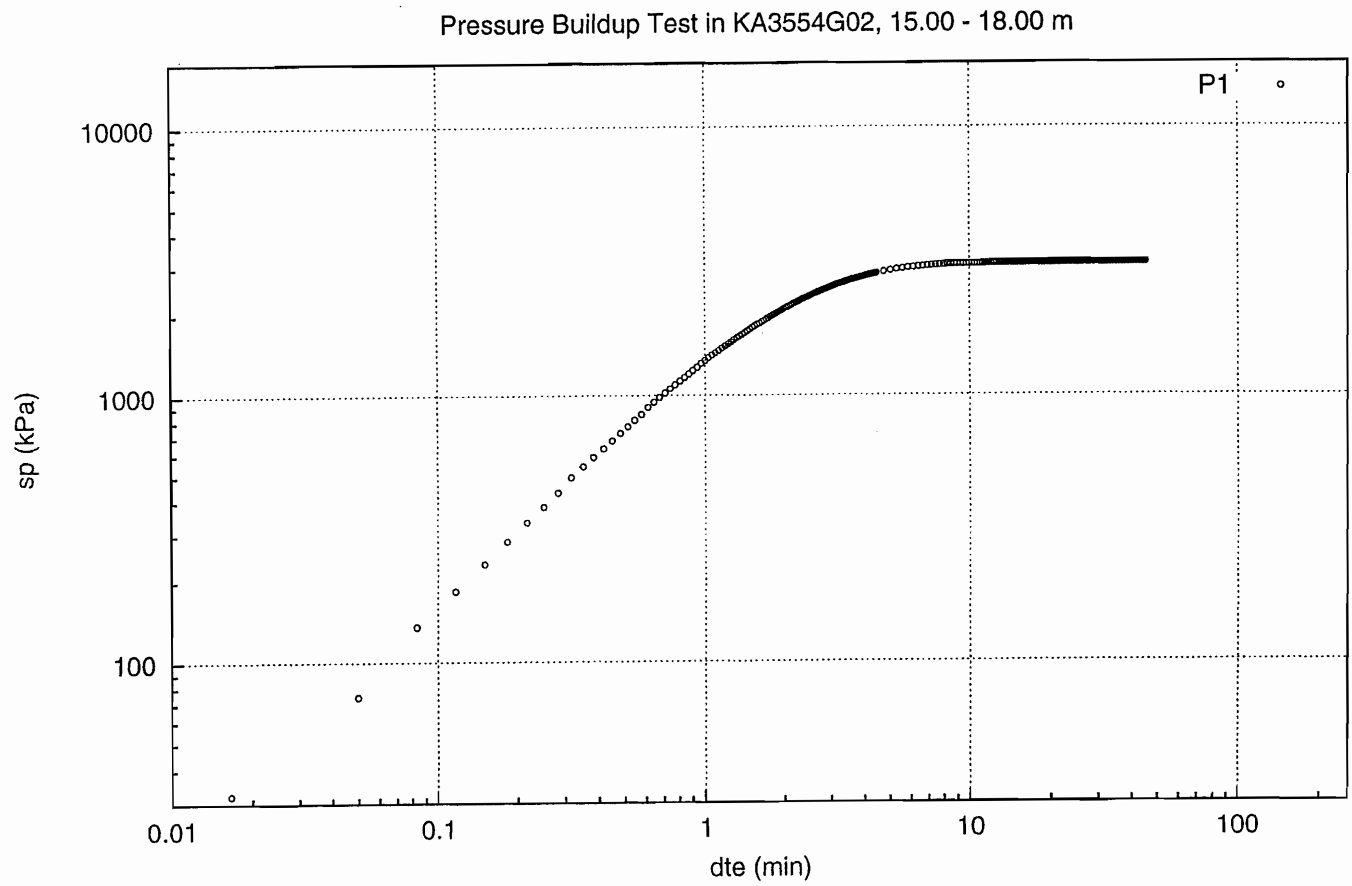


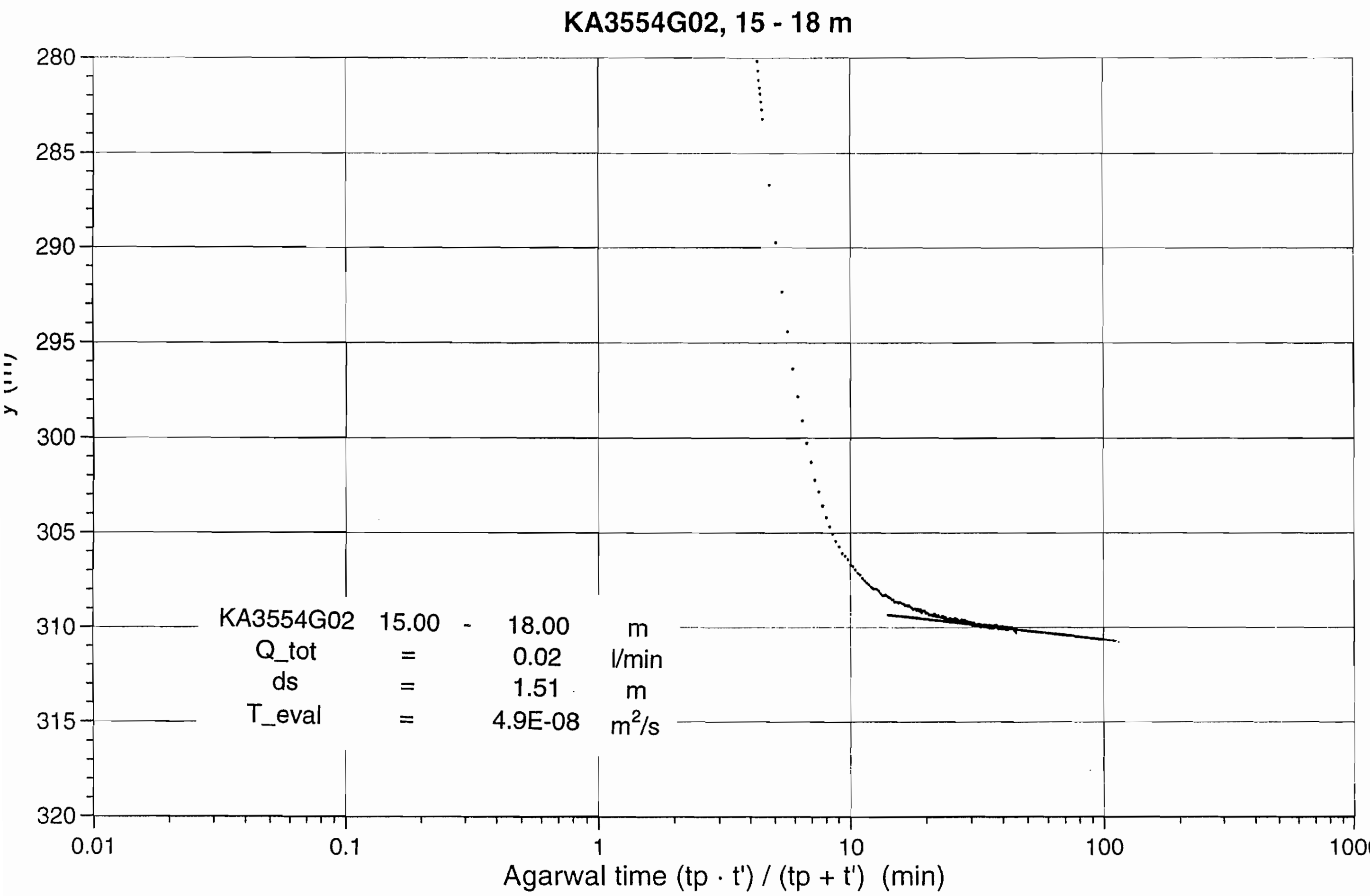


/13080198/DATA/bholeb03/utv_03/34pb3554.grf 04/22/99

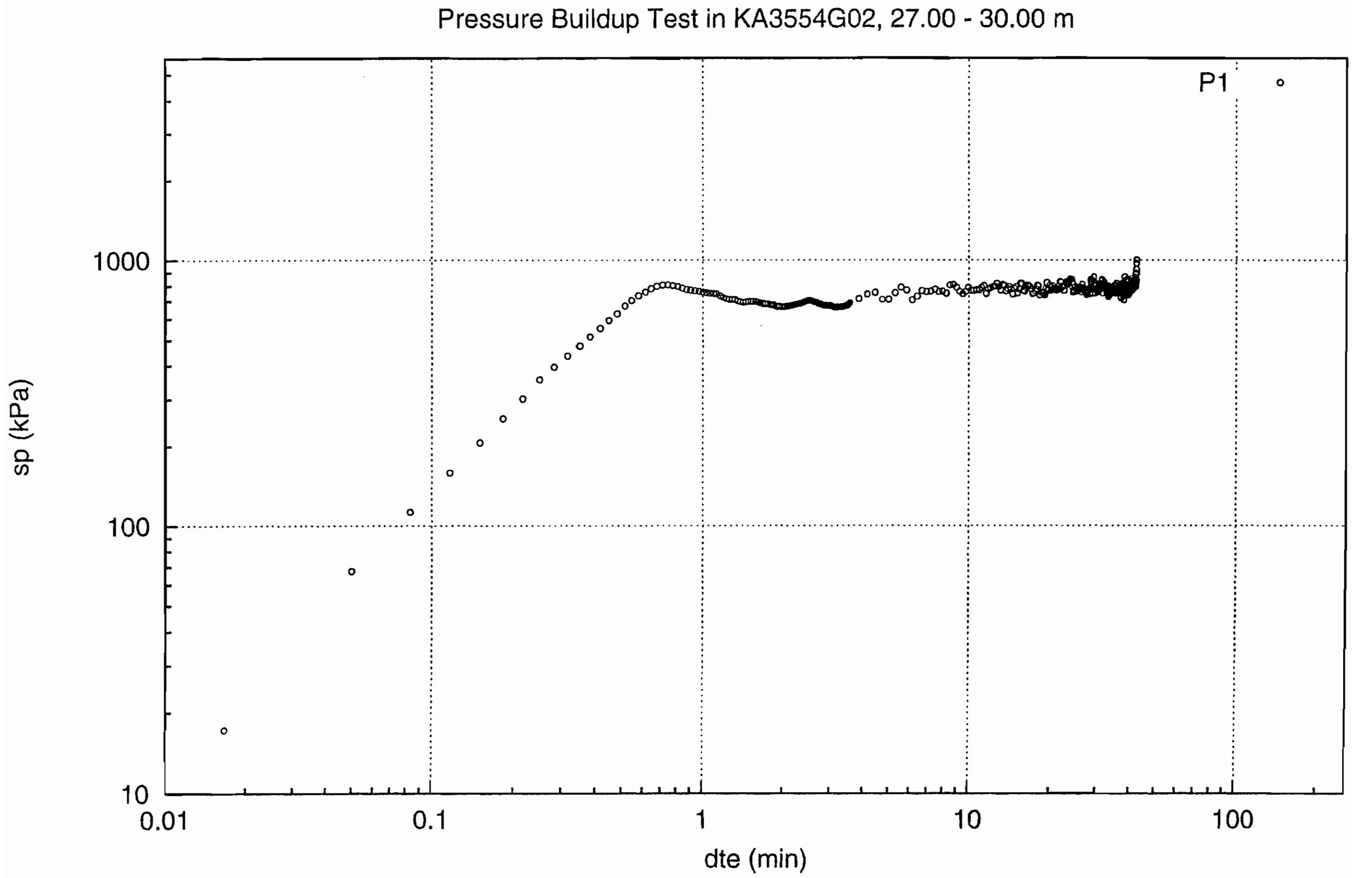

Pressure Buildup Test in KA3554G02, 12.00 - 15.00 m
P1
100000
10000
1000
sp (kPa)
0.01
0.1
1
10
100
dte (min)

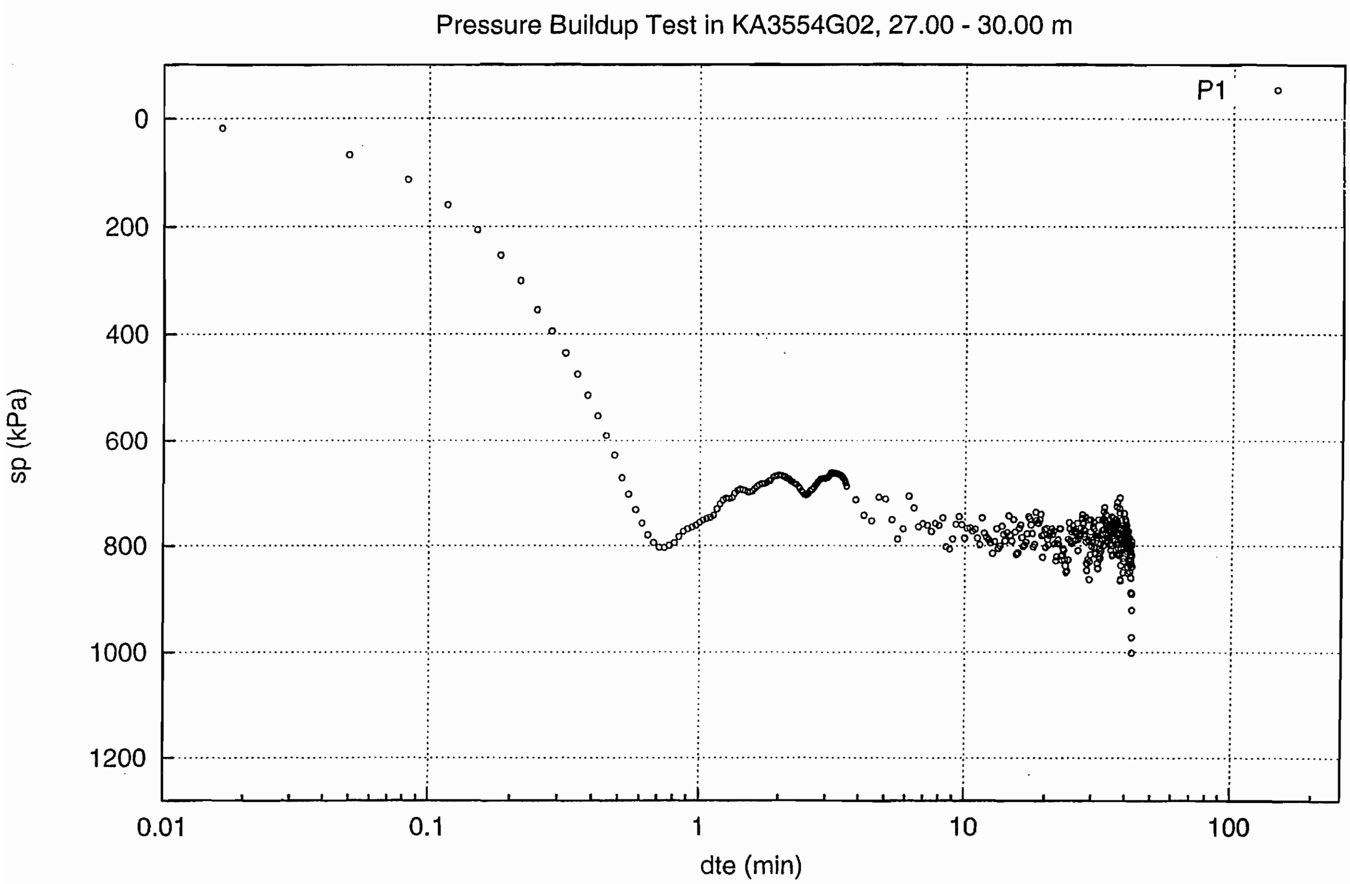

Pressure Buildup Test in KA3554G02, 12.00 - 15.00 m
P1
2000
2200
2400
2600
2800
3000
3200
sp (kPa)
KA3554G02 12.00 - 15.00 m
Q_tot = 0.33 l/min
ds = 2.67 m
T_eval = 3.8E-07 m²/s
0.01
0.1
1
10
100
dte (min)

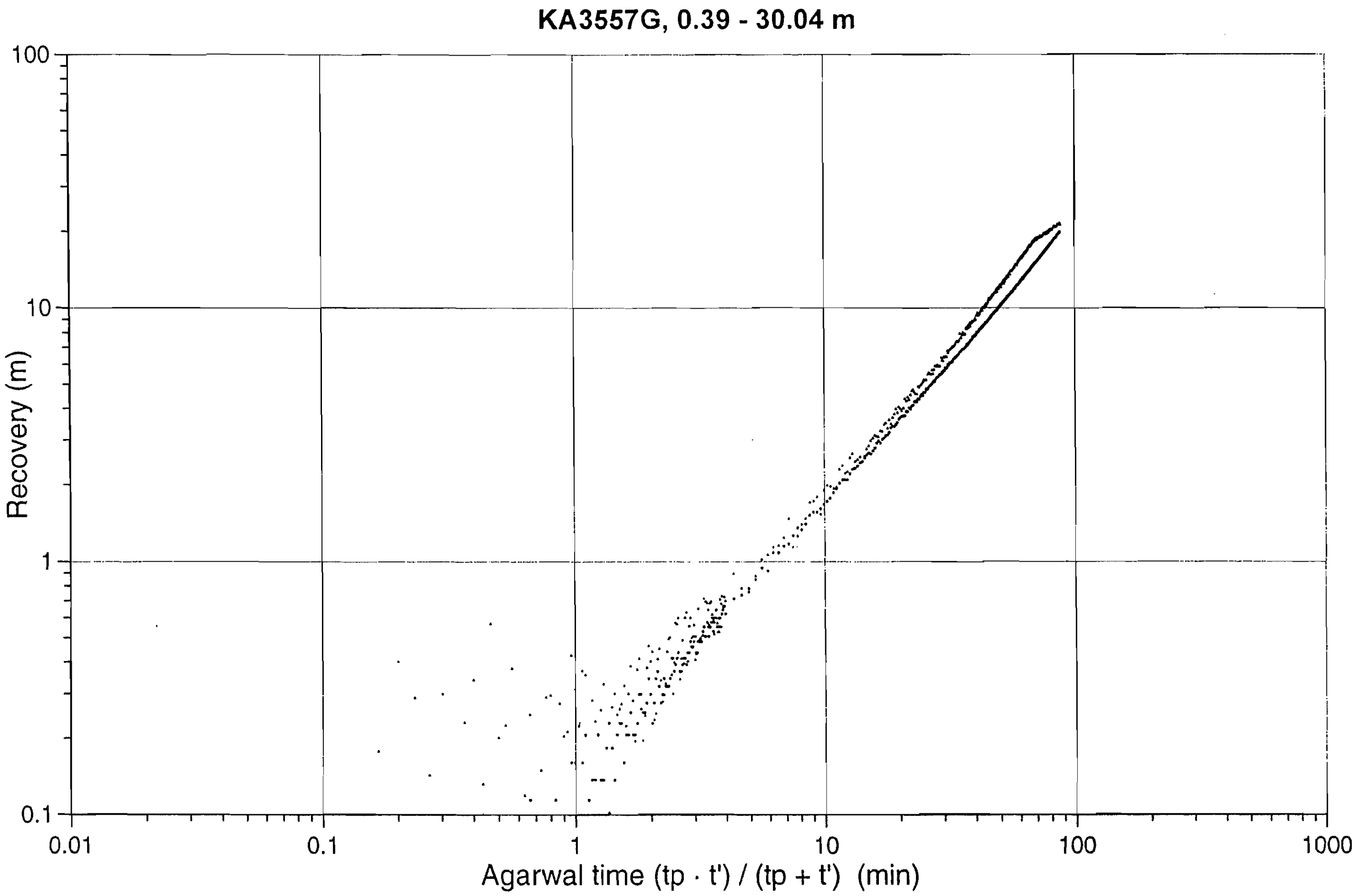




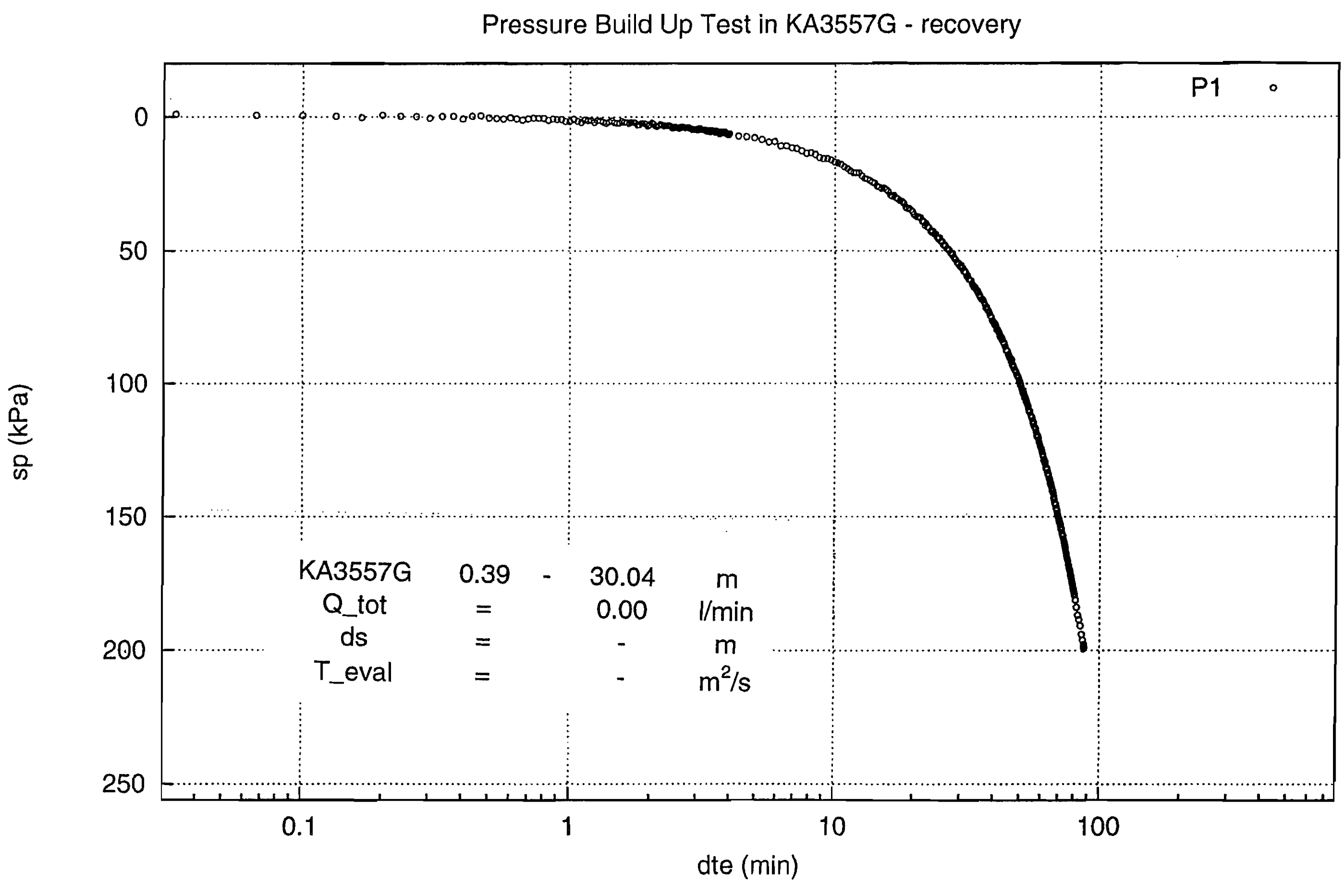
/13080198/DATA/bhole603/ulv_03/36pb3554.grf 04/22/99


Pressure Buildup Test in KA3554G02, 27.00 - 30.00 m
P1
sp (kPa)
1000
100
10
0.01
0.1
1
10
100
dte (min)

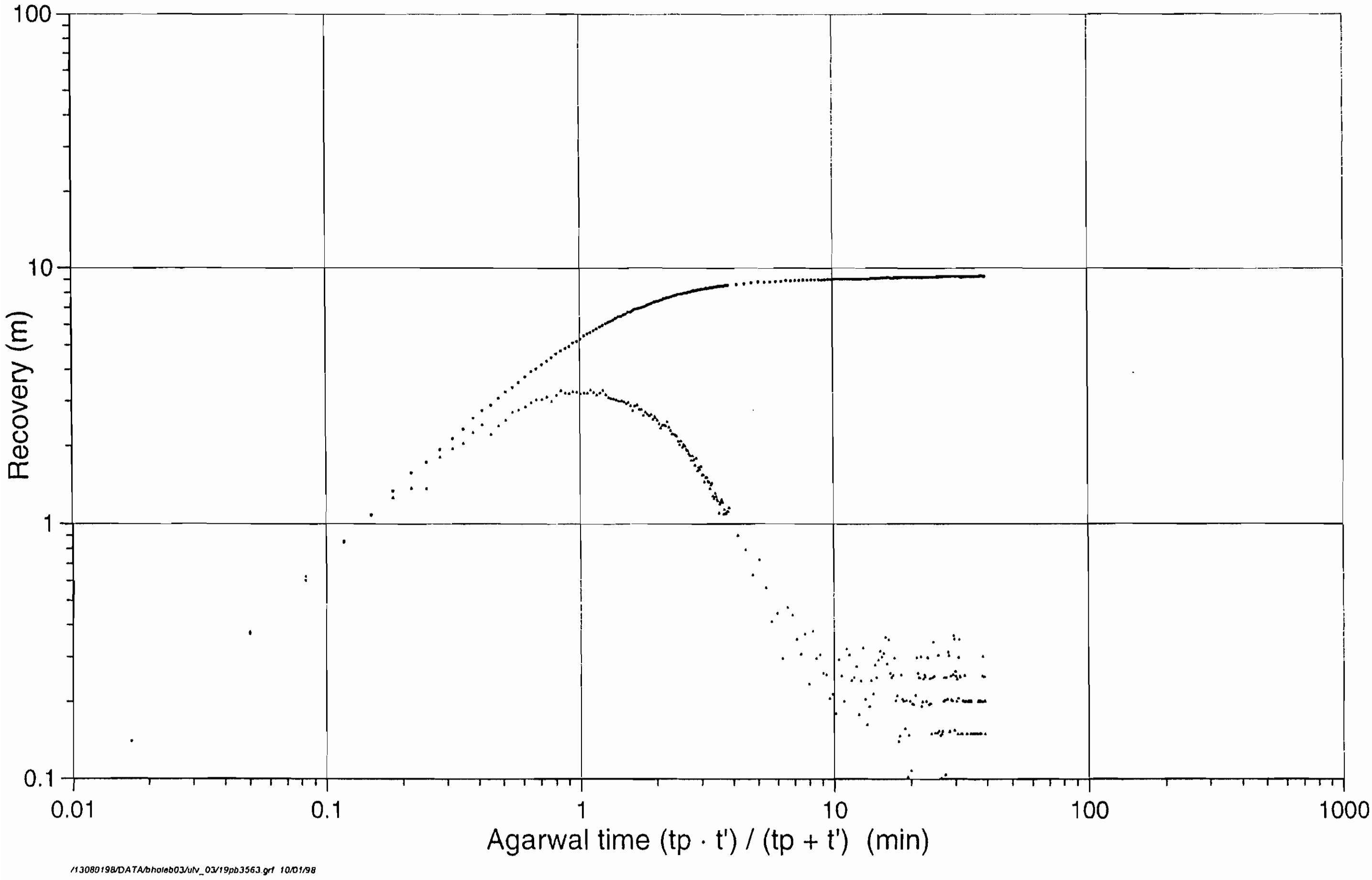

Pressure Buildup Test in KA3554G02, 27.00 - 30.00 m
P1
sp (kPa)
0
200
400
600
800
1000
1200
0.01
0.1
1
10
100
dte (min)



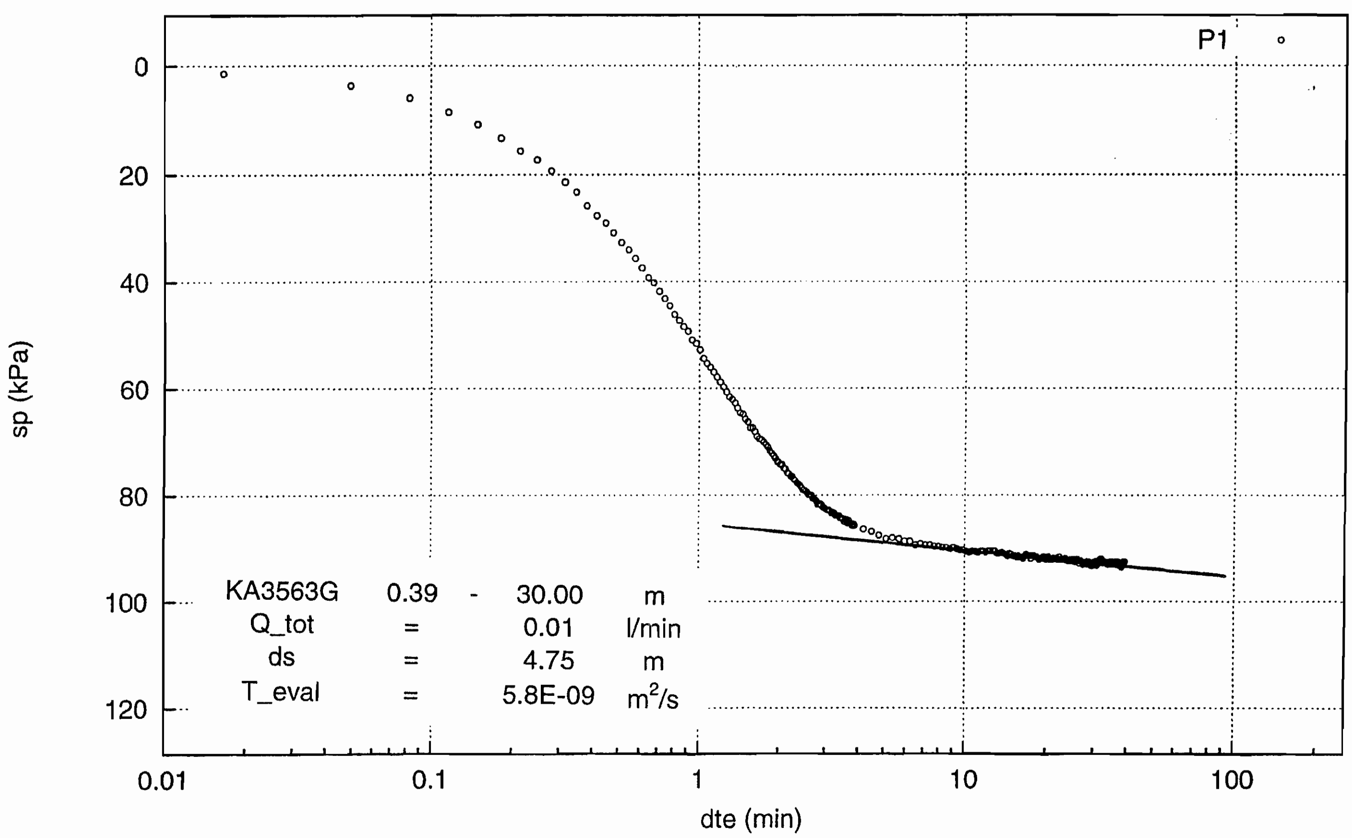
/13080198/DATA/bholeb03/utv_03/15pb3557.grf 10/01/98

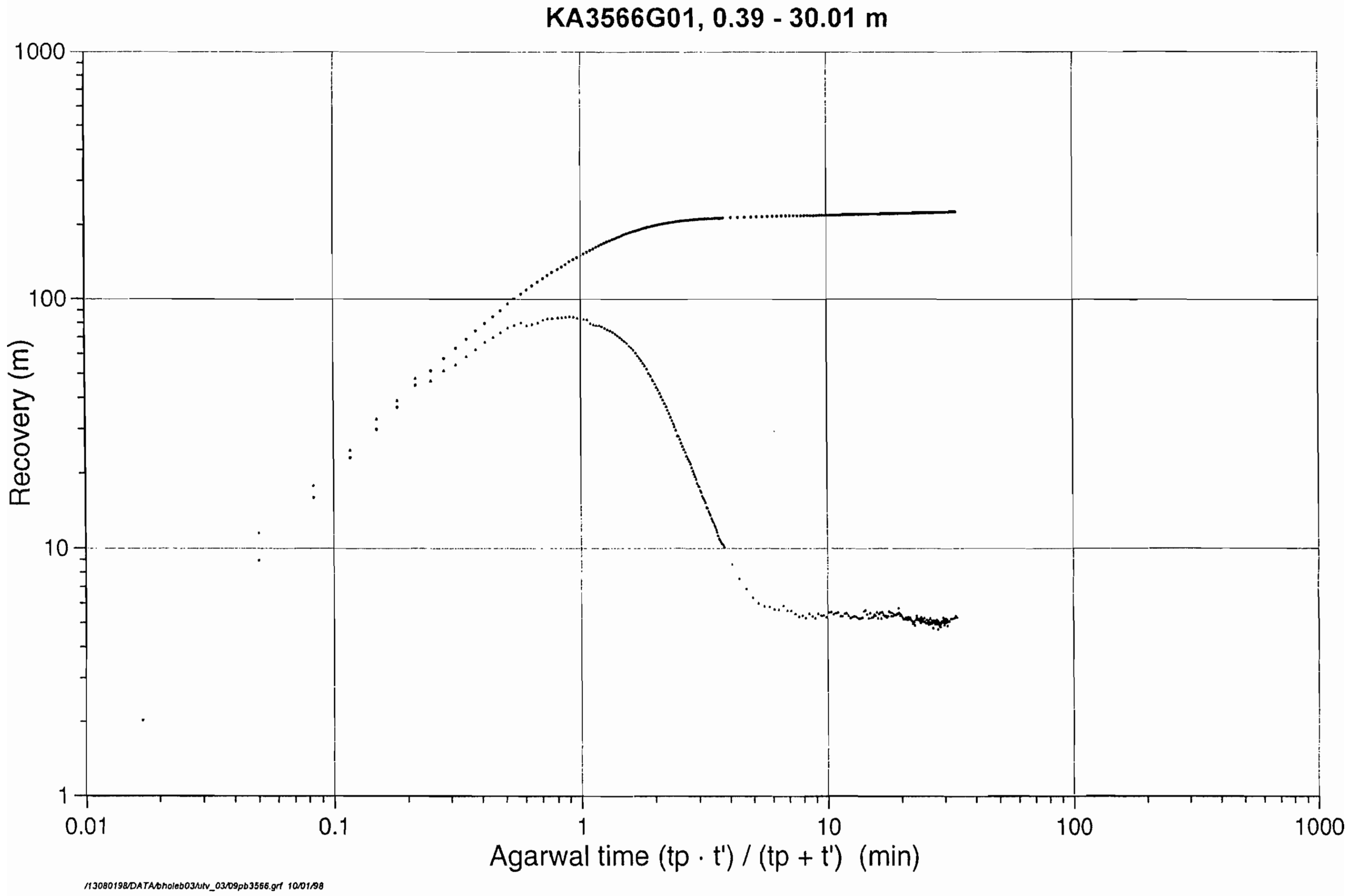


KA3563G, 0.39 - 30.00 m

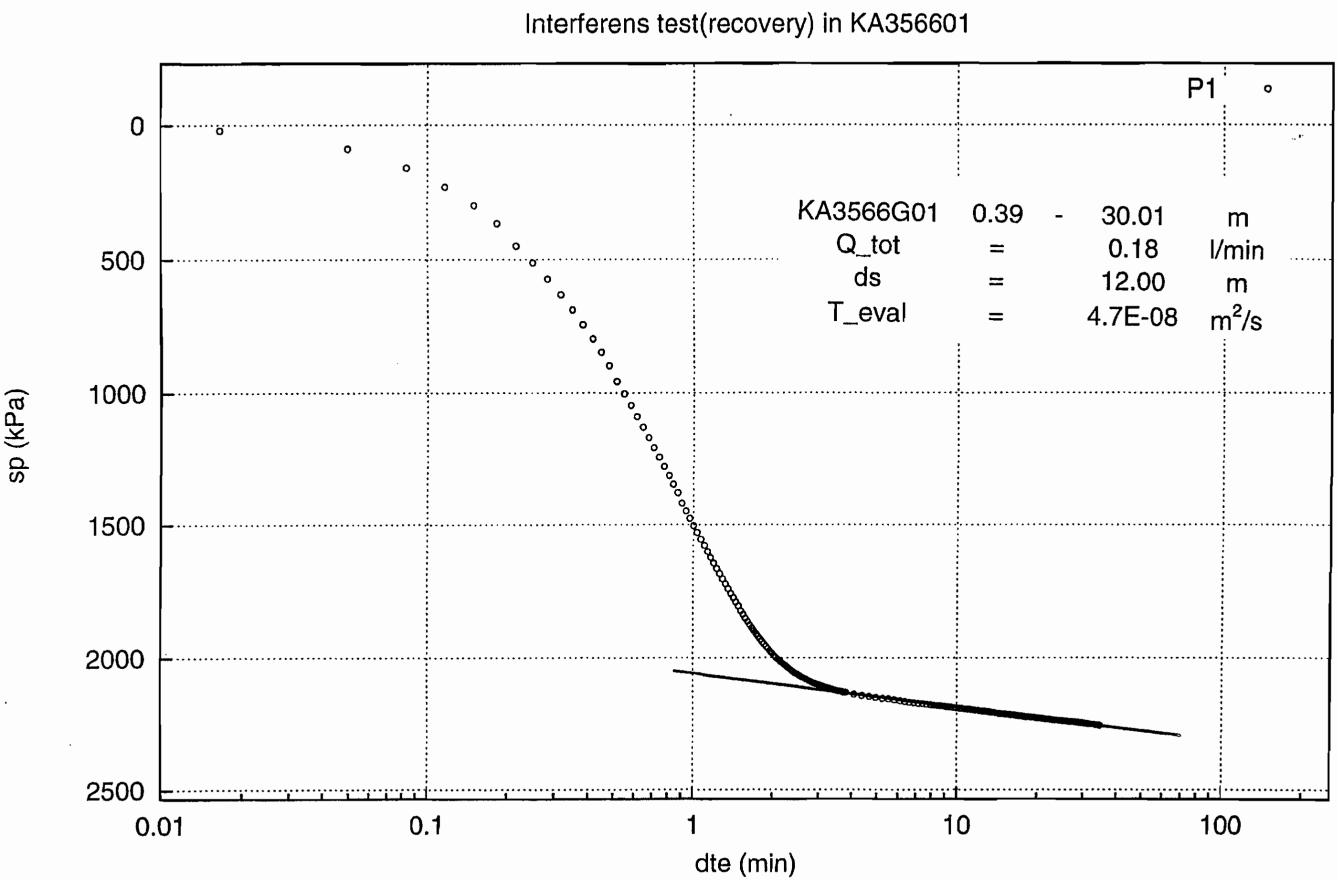


Pressure Build-up Test(recovery) in KA3563G(P1)

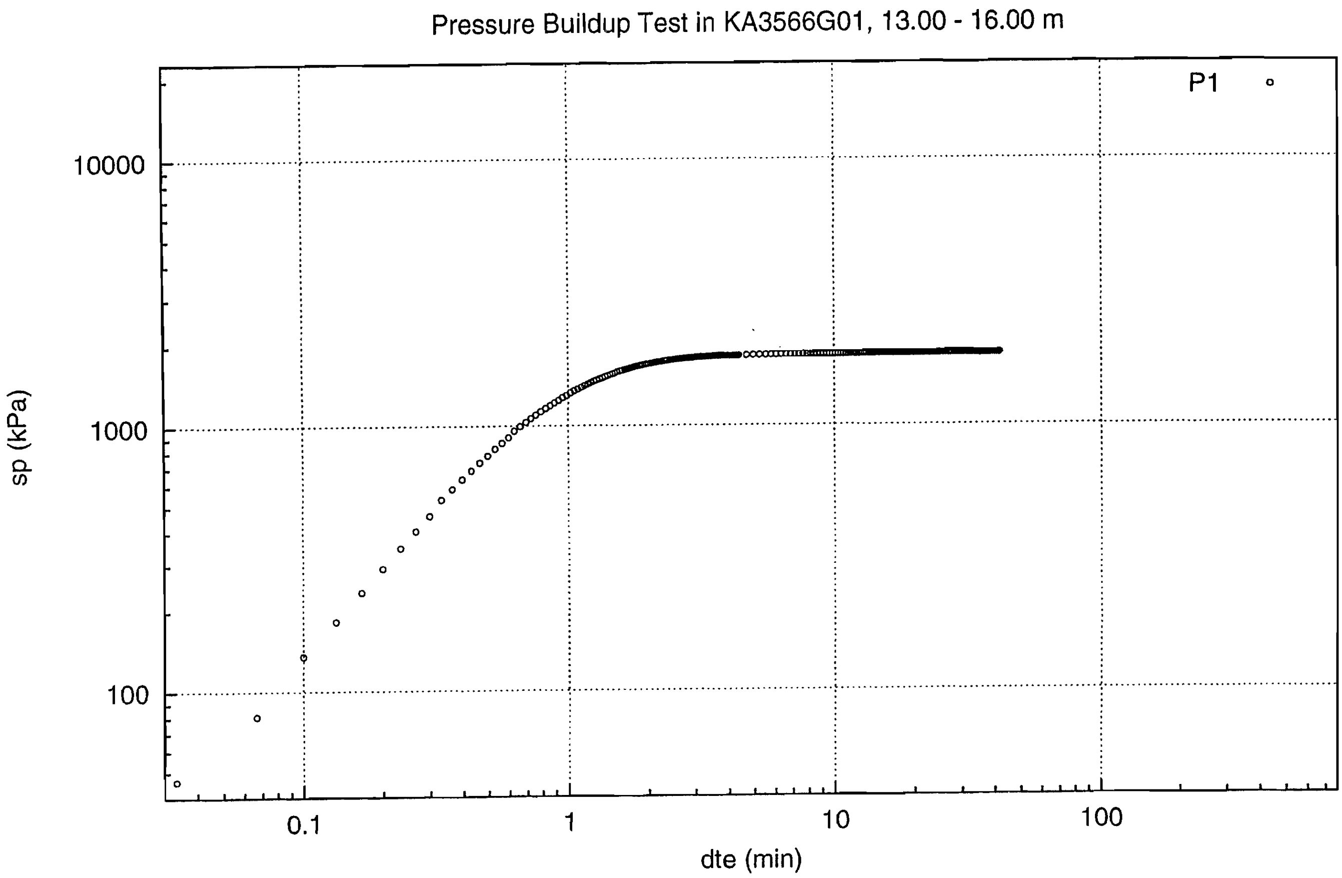


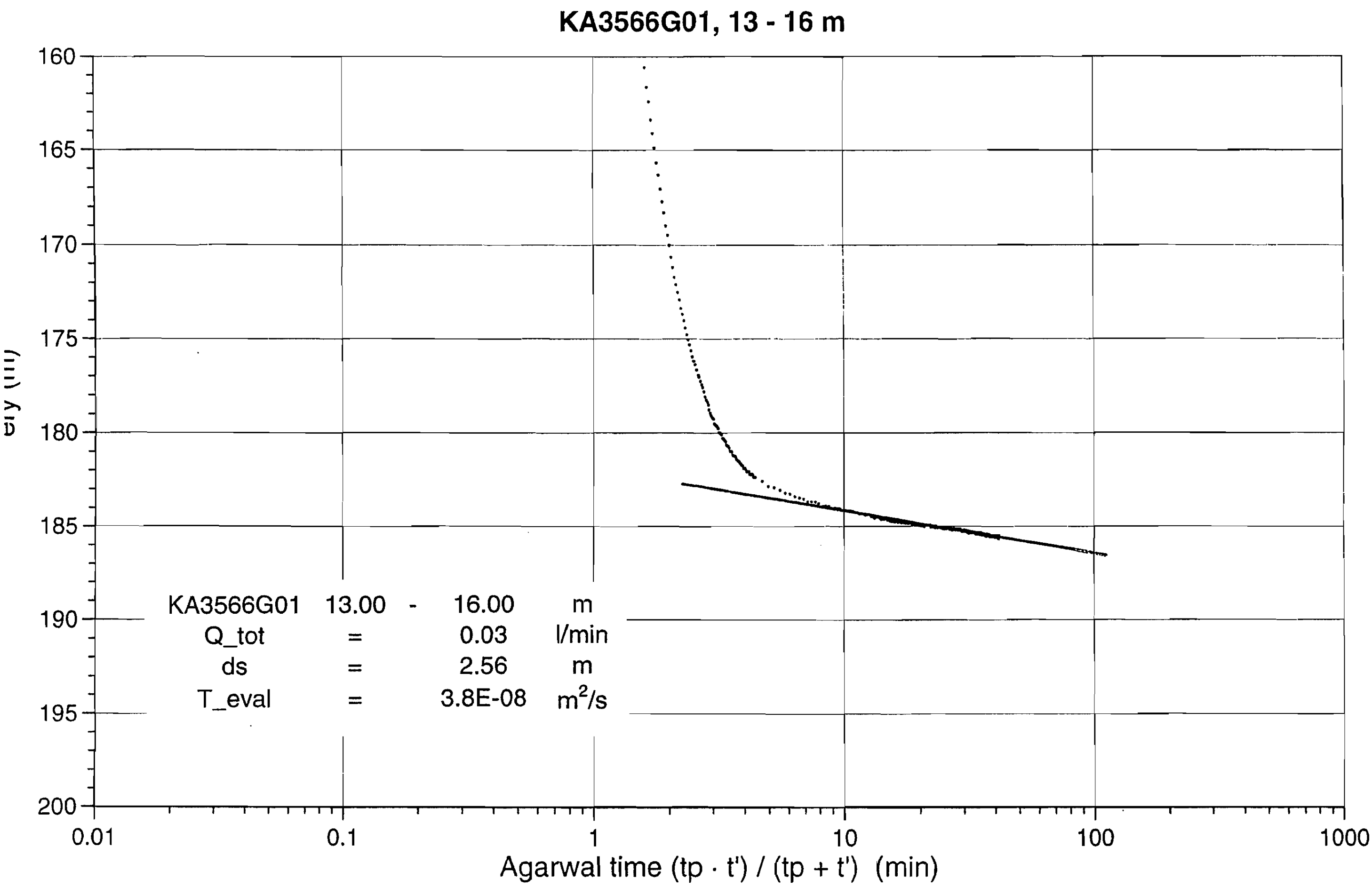


KA3566G01, 0.39 - 30.01 m
1000
100
10
1
Recovery (m)
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/09pb3566.grf 10/01/98

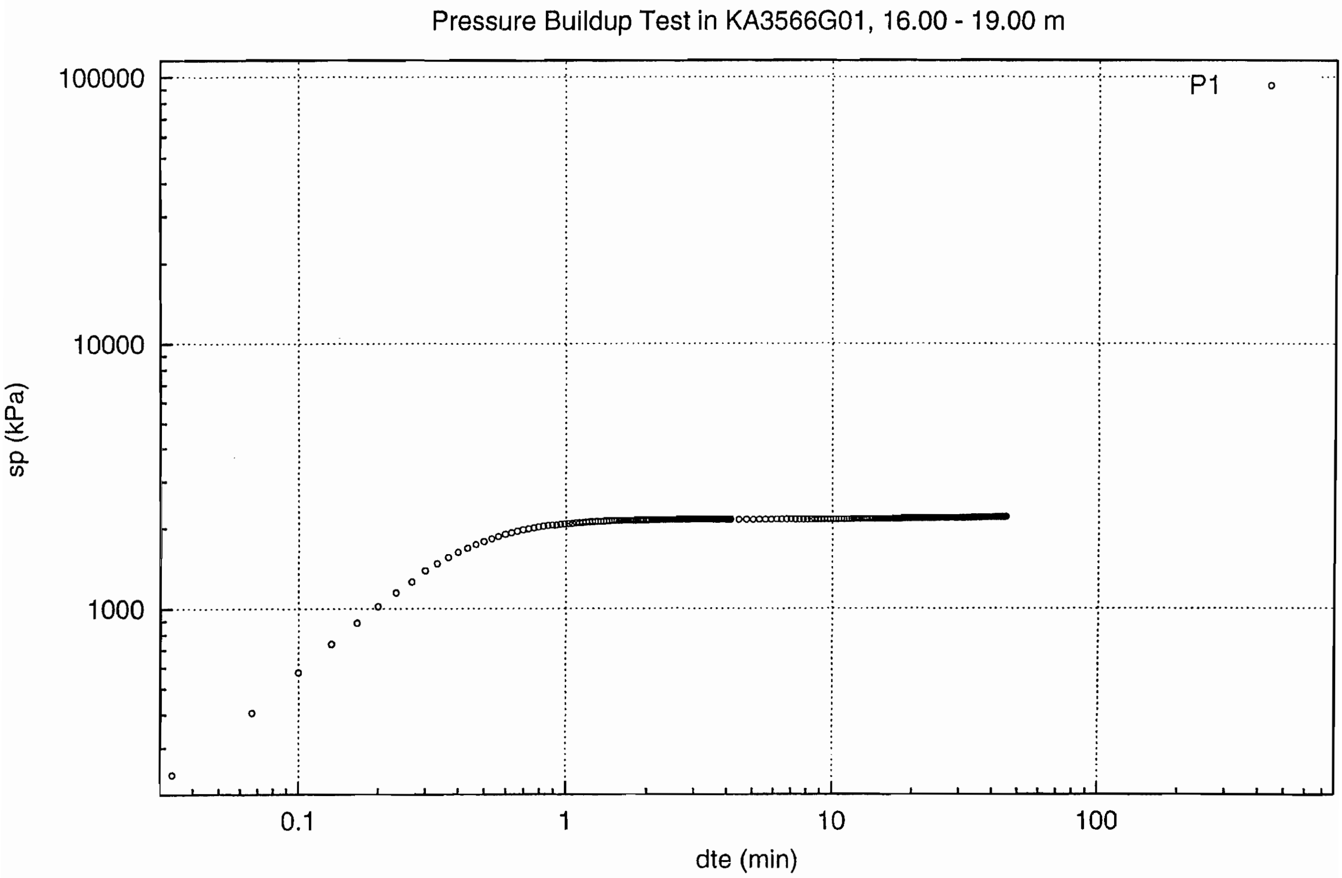


Interferens test(recovery) in KA356601
P1
KA3566G01 0.39 - 30.01 m
Q_tot = 0.18 l/min
ds = 12.00 m
T_eval = 4.7E-08 m²/s
0
500
1000
1500
2000
2500
sp (kPa)
0.01
0.1
1
10
100
dte (min)

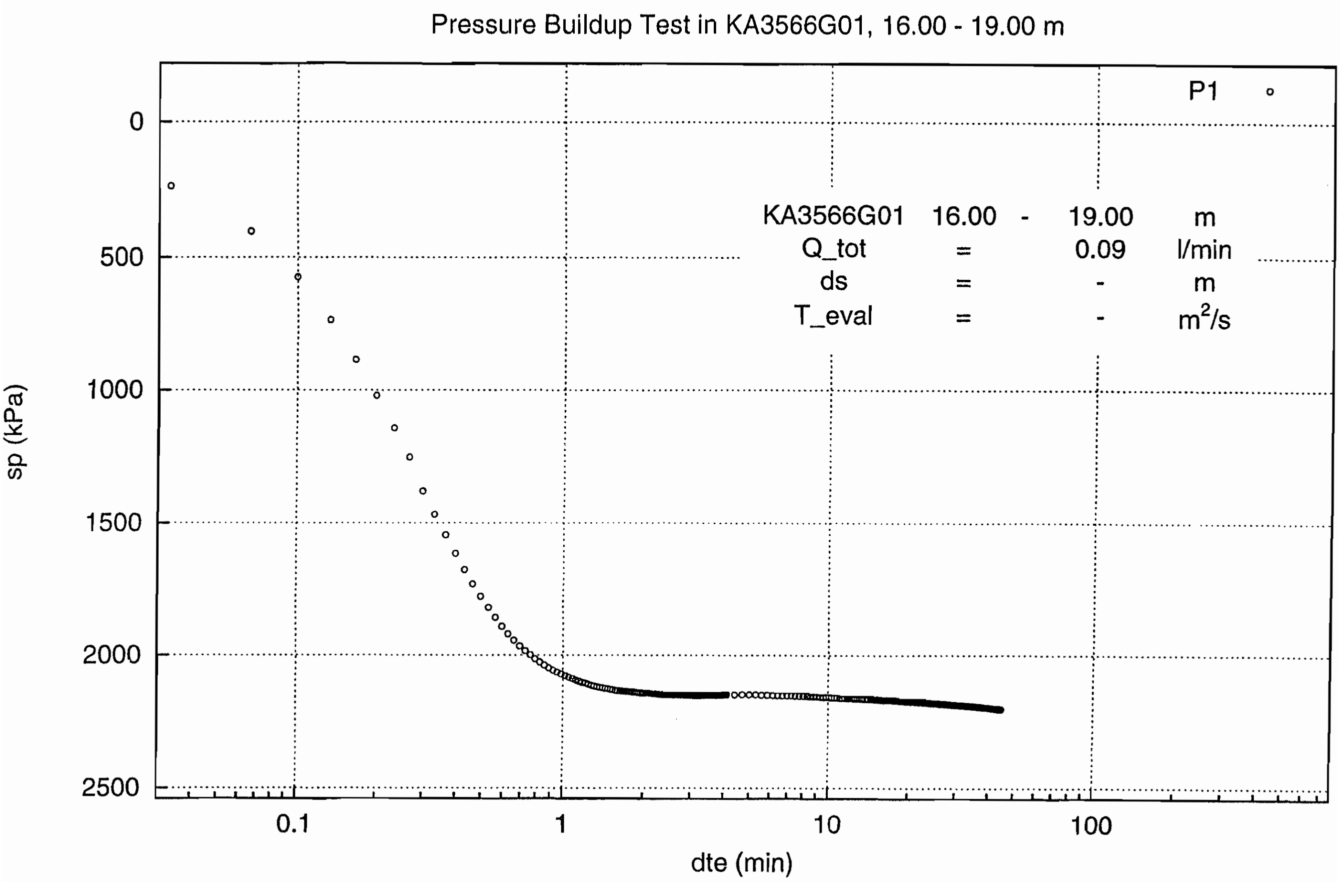




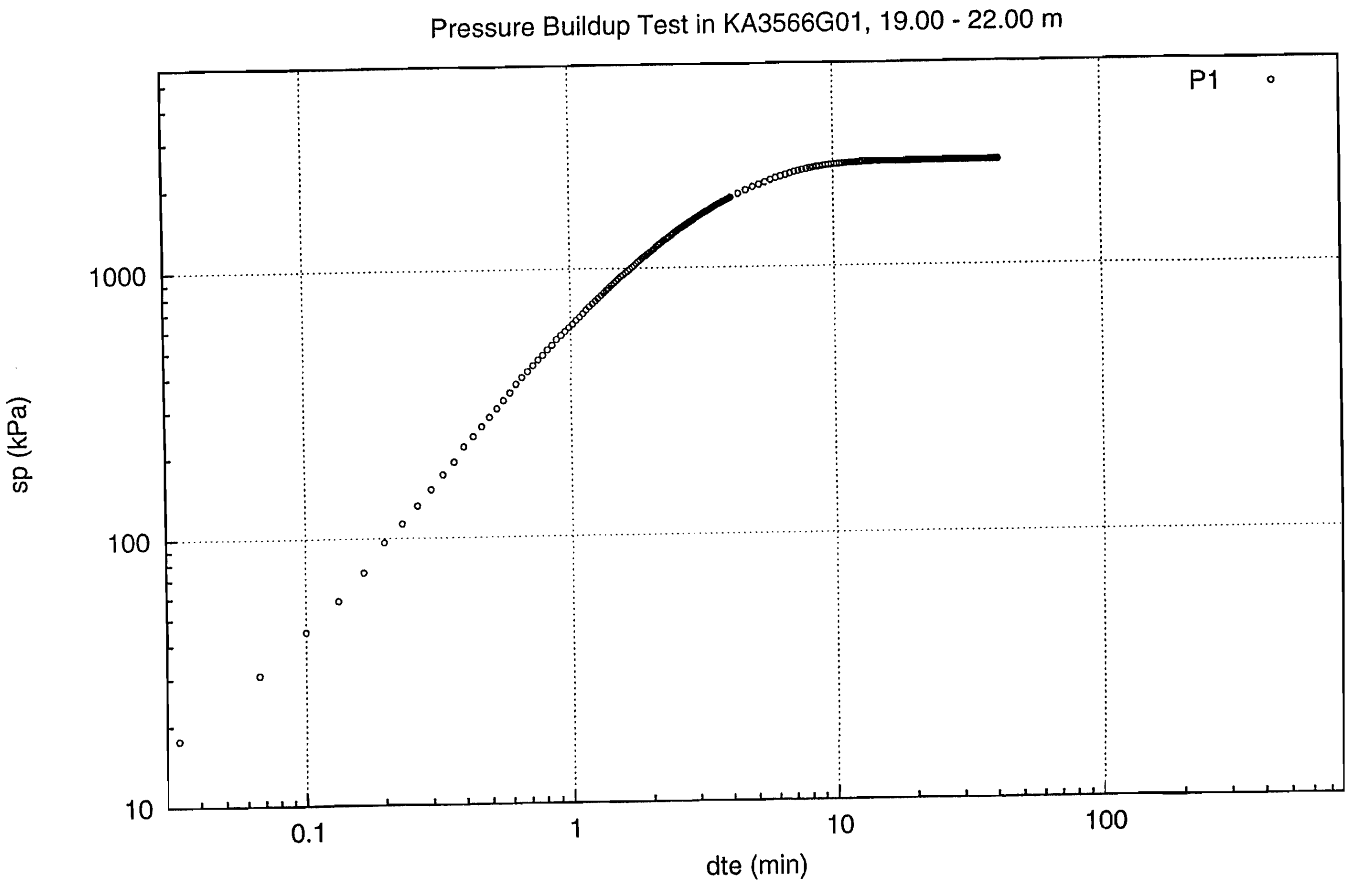
/13080198/DATA/bholeb03/ulv_03/27pb3566.grf 04/22/99

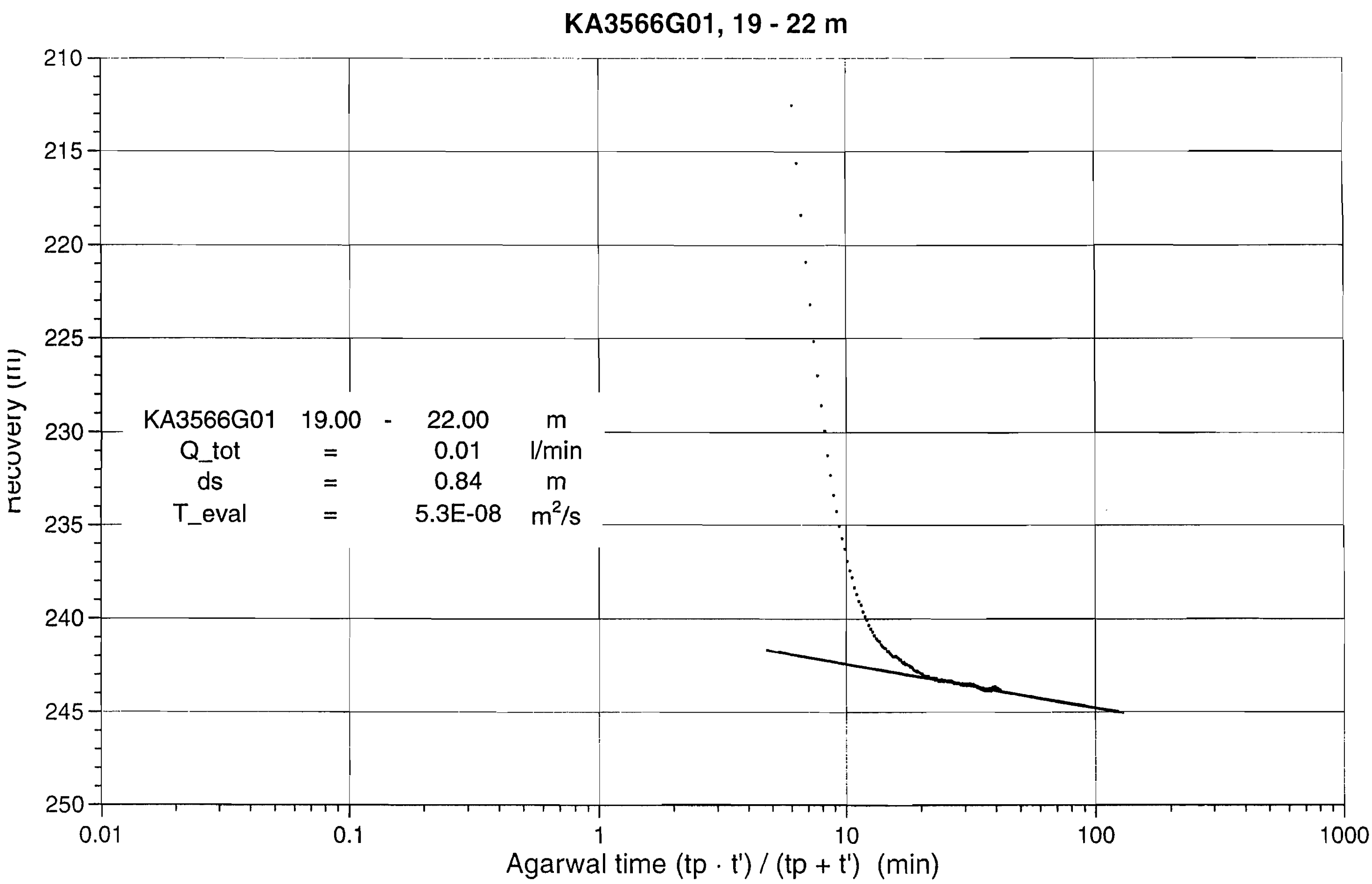


Pressure Buildup Test in KA3566G01, 16.00 - 19.00 m
P1
100000
10000
1000
sp (kPa)
0.1
1
10
100
dte (min)

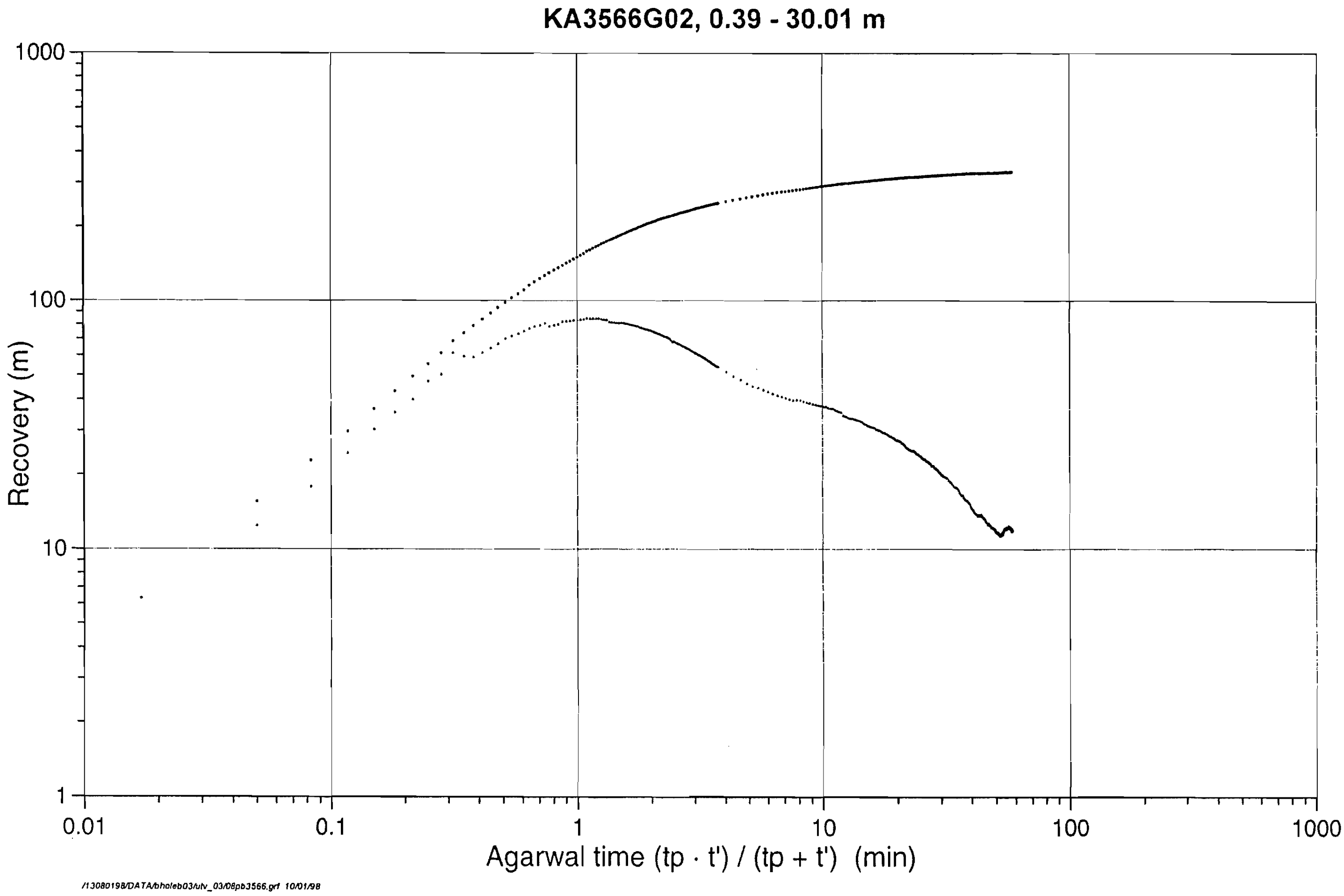


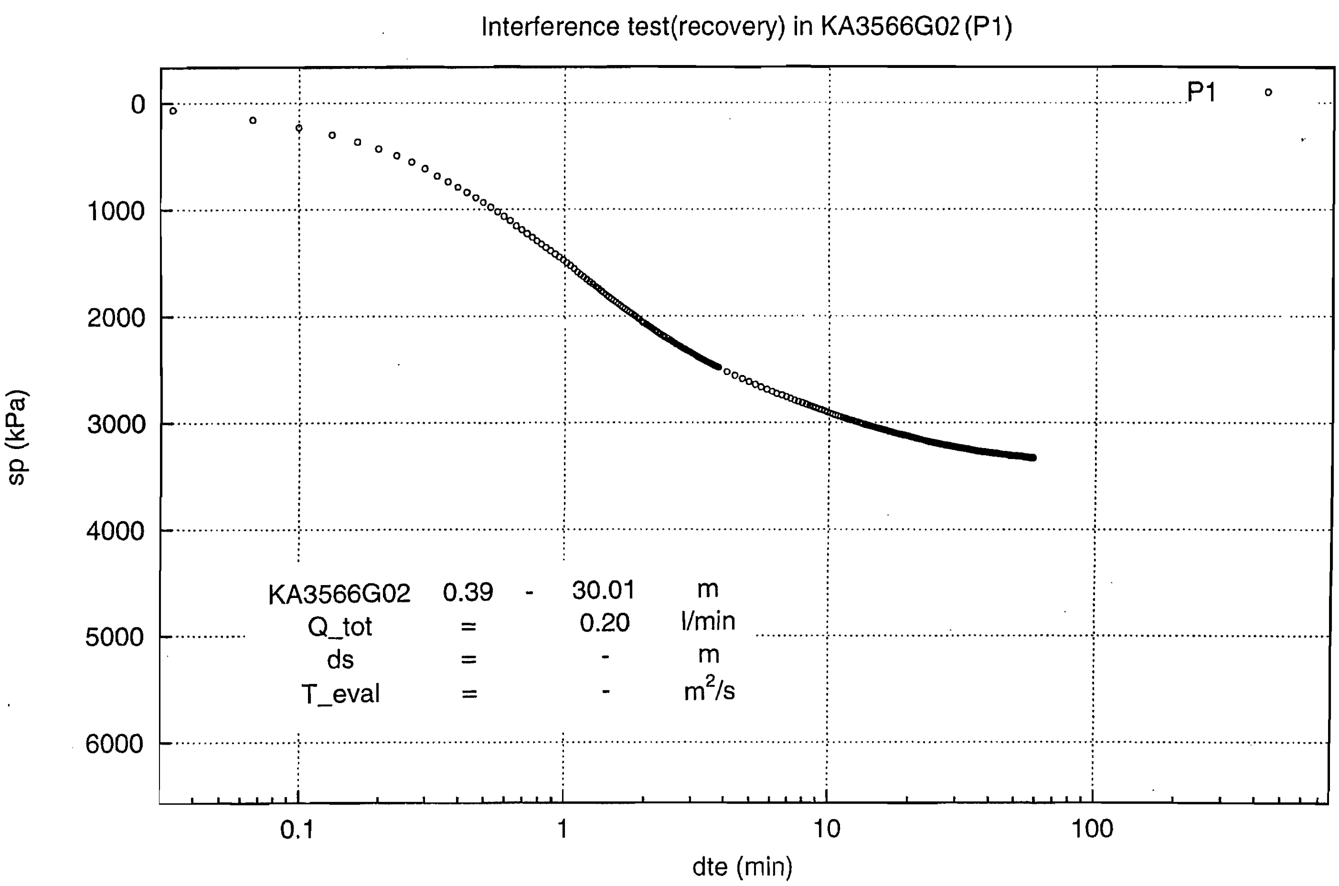
Pressure Buildup Test in KA3566G01, 16.00 - 19.00 m
P1
KA3566G01 16.00 - 19.00 m
Q_tot = 0.09 l/min
ds = - m
T_eval = - m2/s
0
500
1000
1500
2000
2500
sp (kPa)
0.1
1
10
100
dte (min)

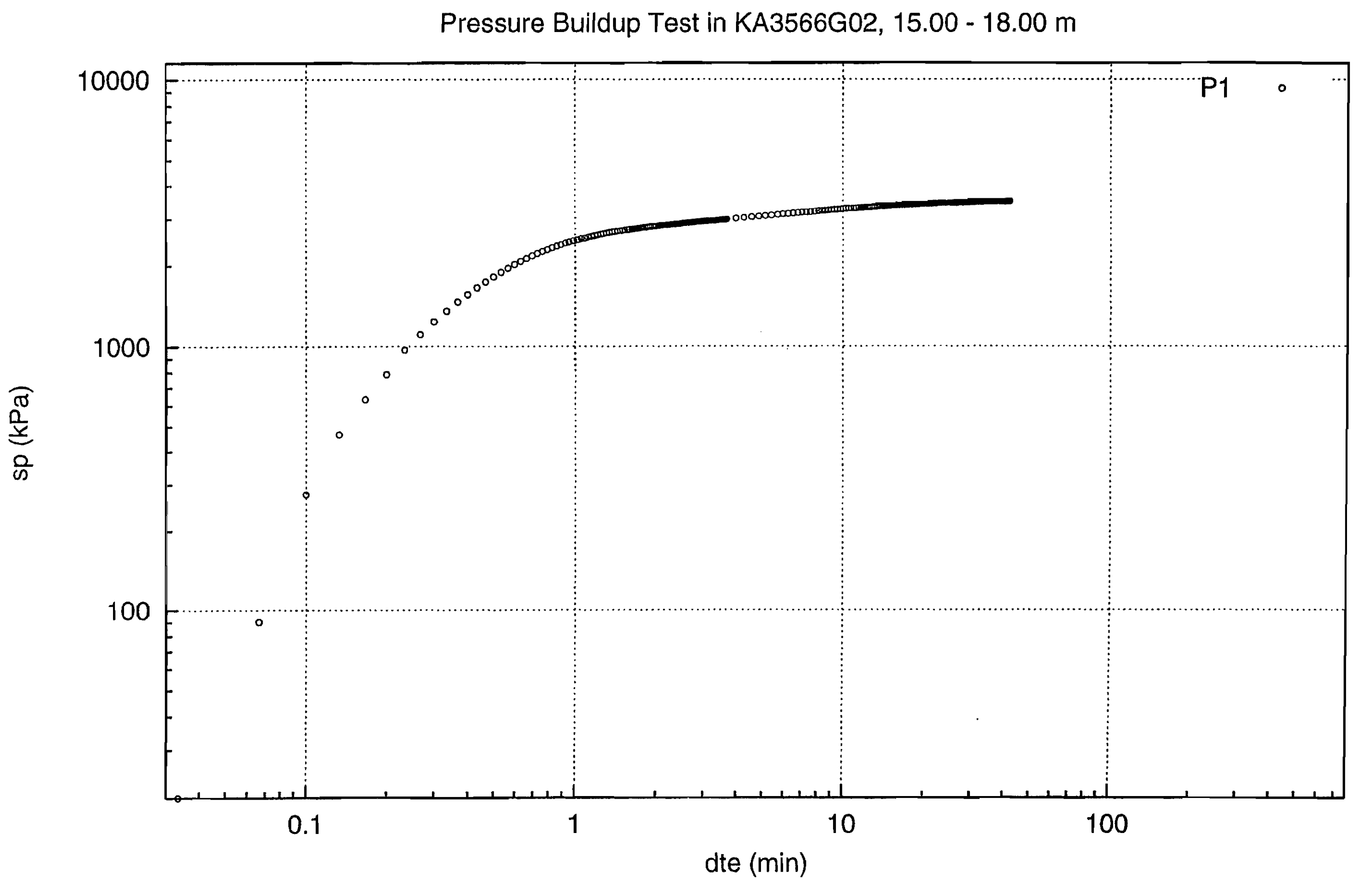




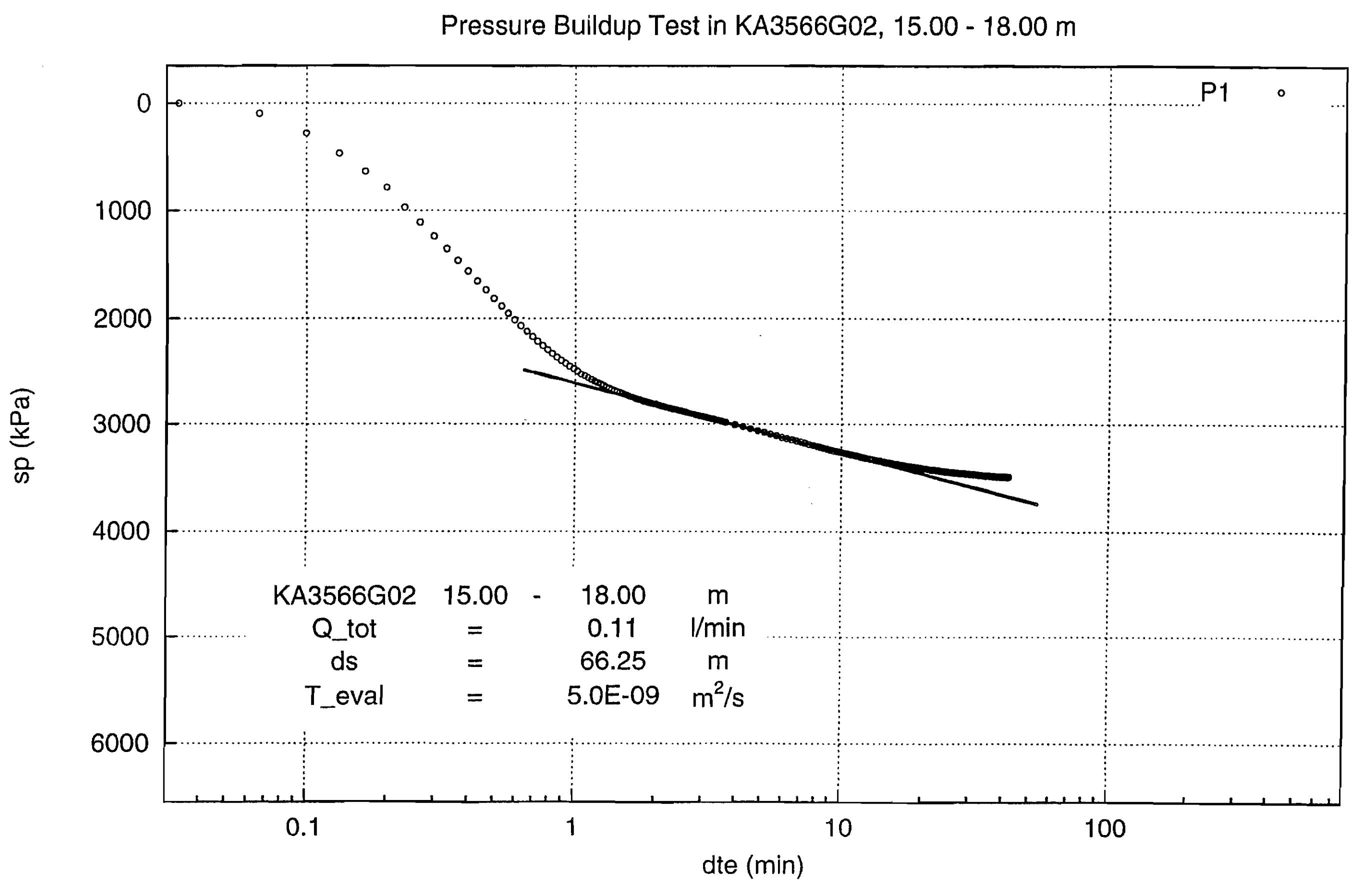
/13080198/DATA/bholeb03/utv_03/29pb3566.grf 04/22/99


KA3566G02, 0.39 - 30.01 m
1000
100
10
1
Recovery (m)
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)

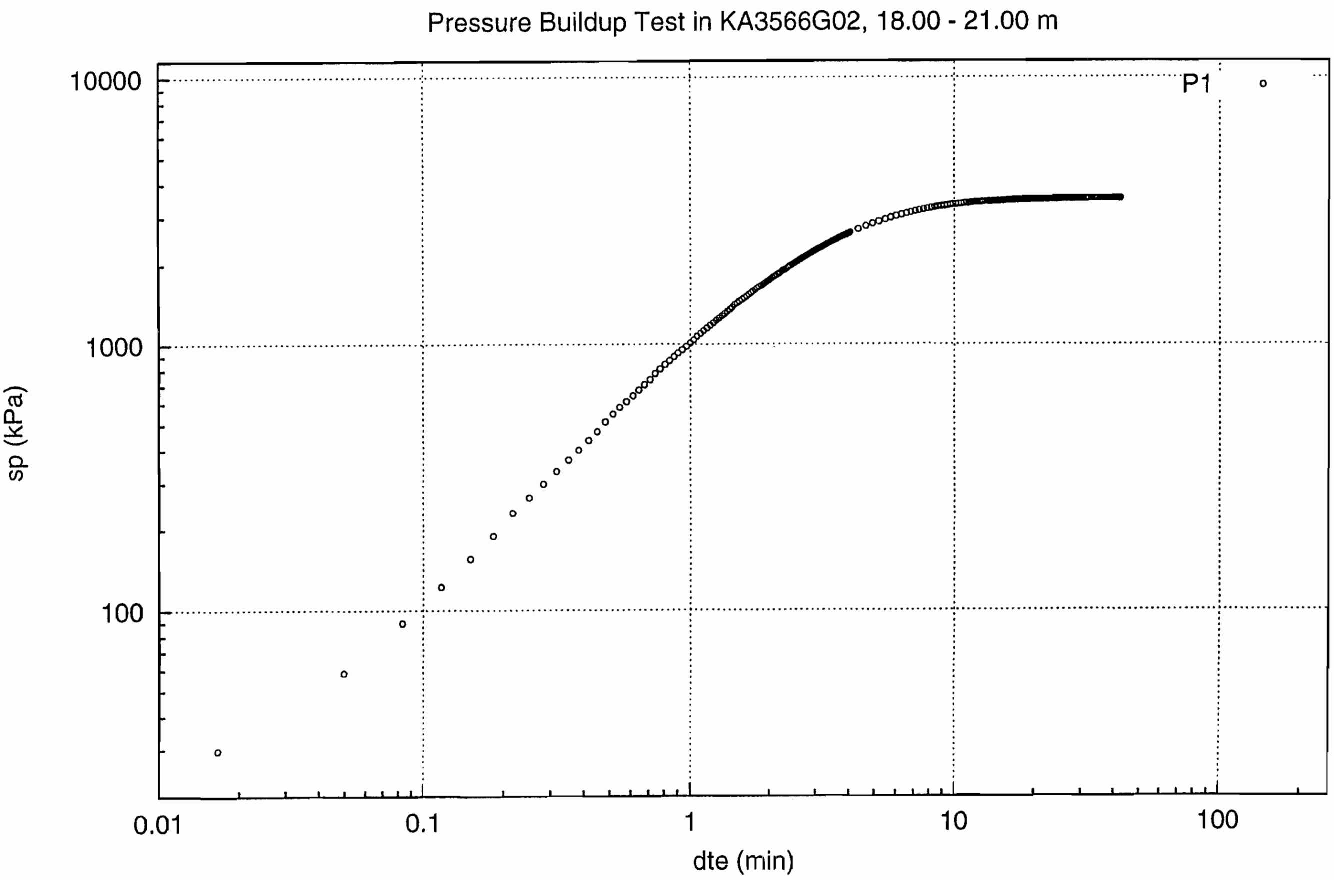

Interference test(recovery) in KA3566G02 (P1)
P1
0
1000
2000
3000
4000
5000
6000
sp (kPa)
KA3566G02 0.39 - 30.01 m
Q_tot = 0.20 l/min
ds = - m
T_eval = - m²/s
0.1
1
10
100
dte (min)

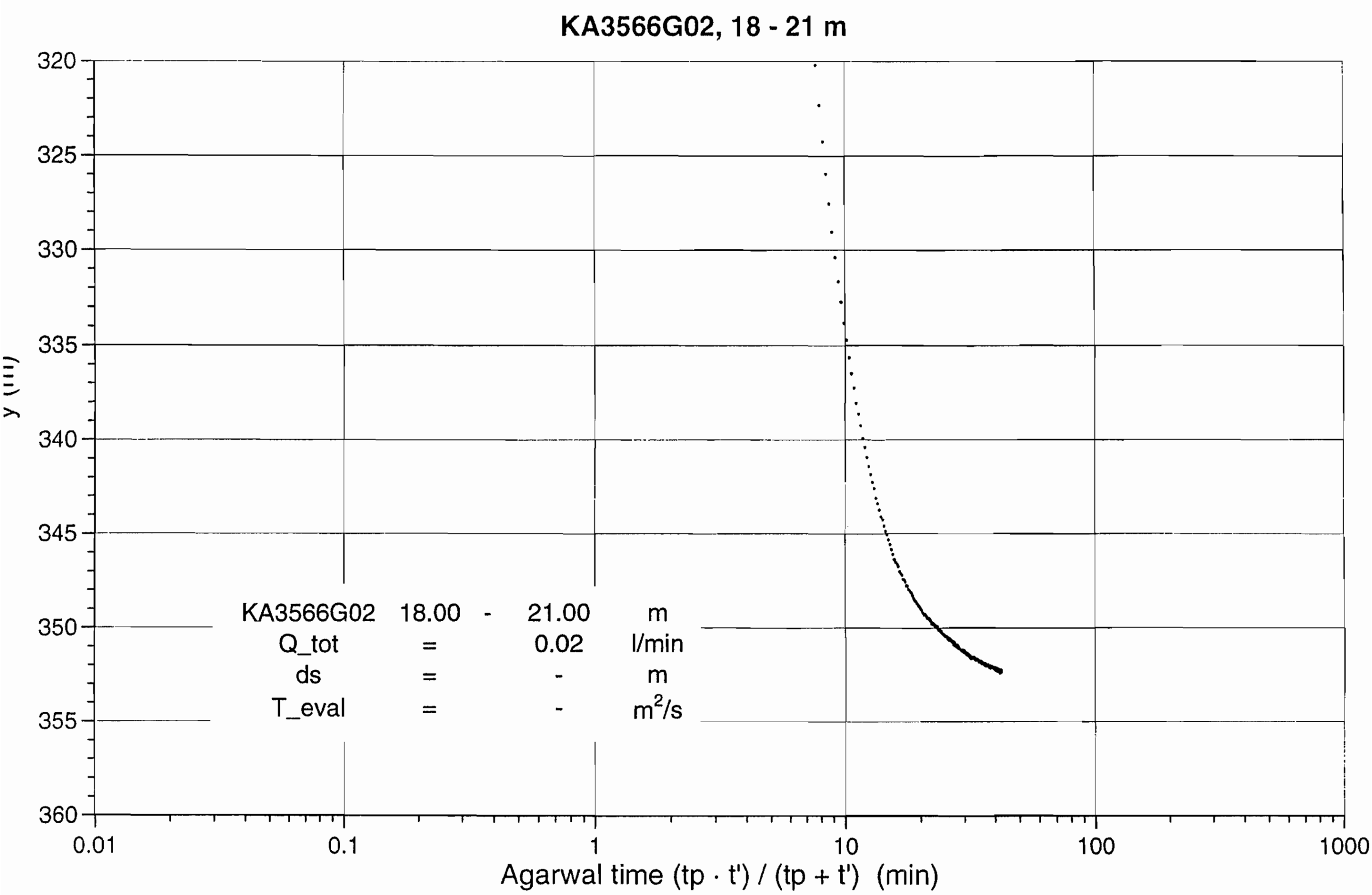


Pressure Buildup Test in KA3566G02, 15.00 - 18.00 m
P1
10000
1000
100
sp (kPa)
0.1
1
10
100
dte (min)

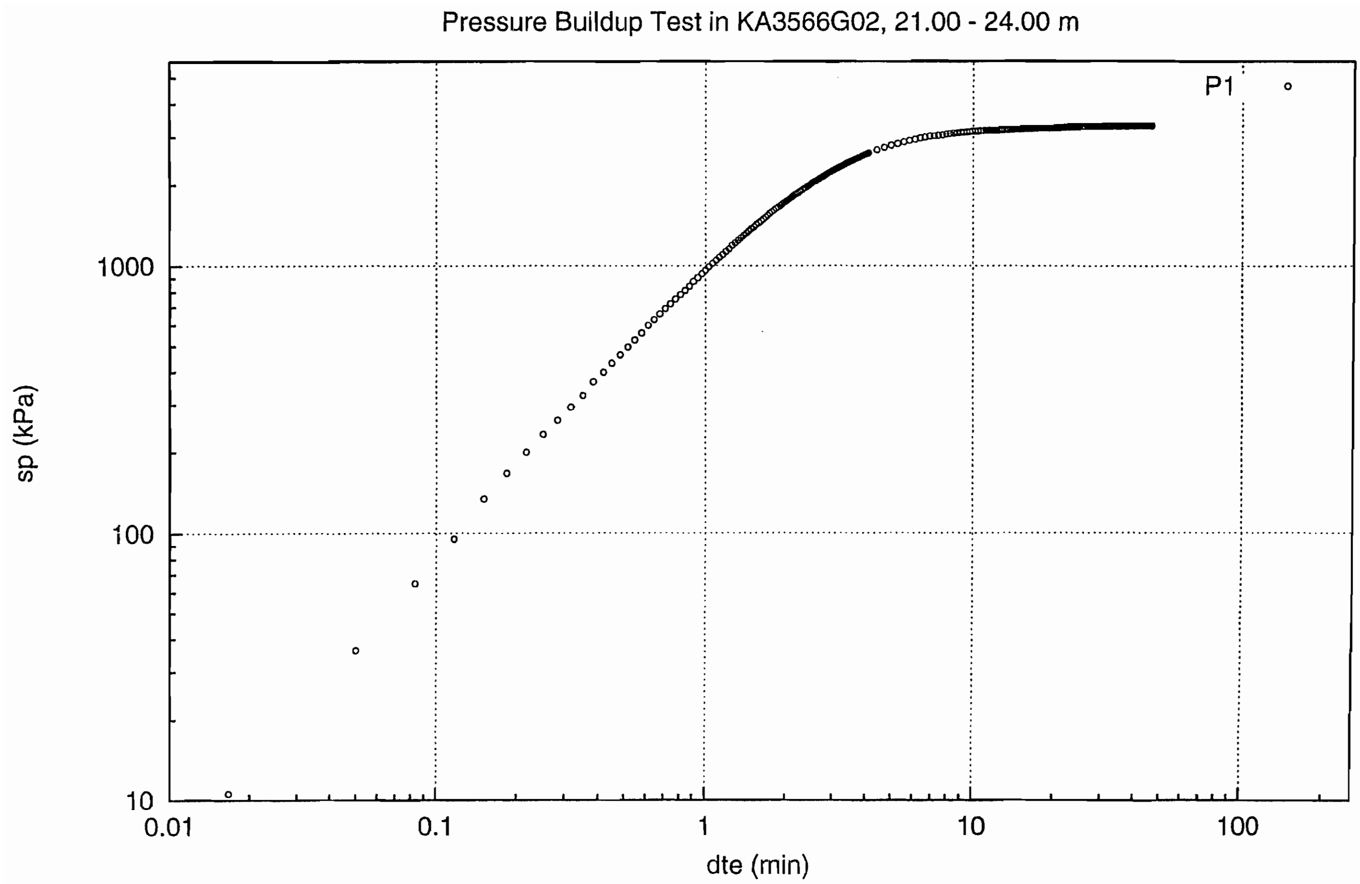


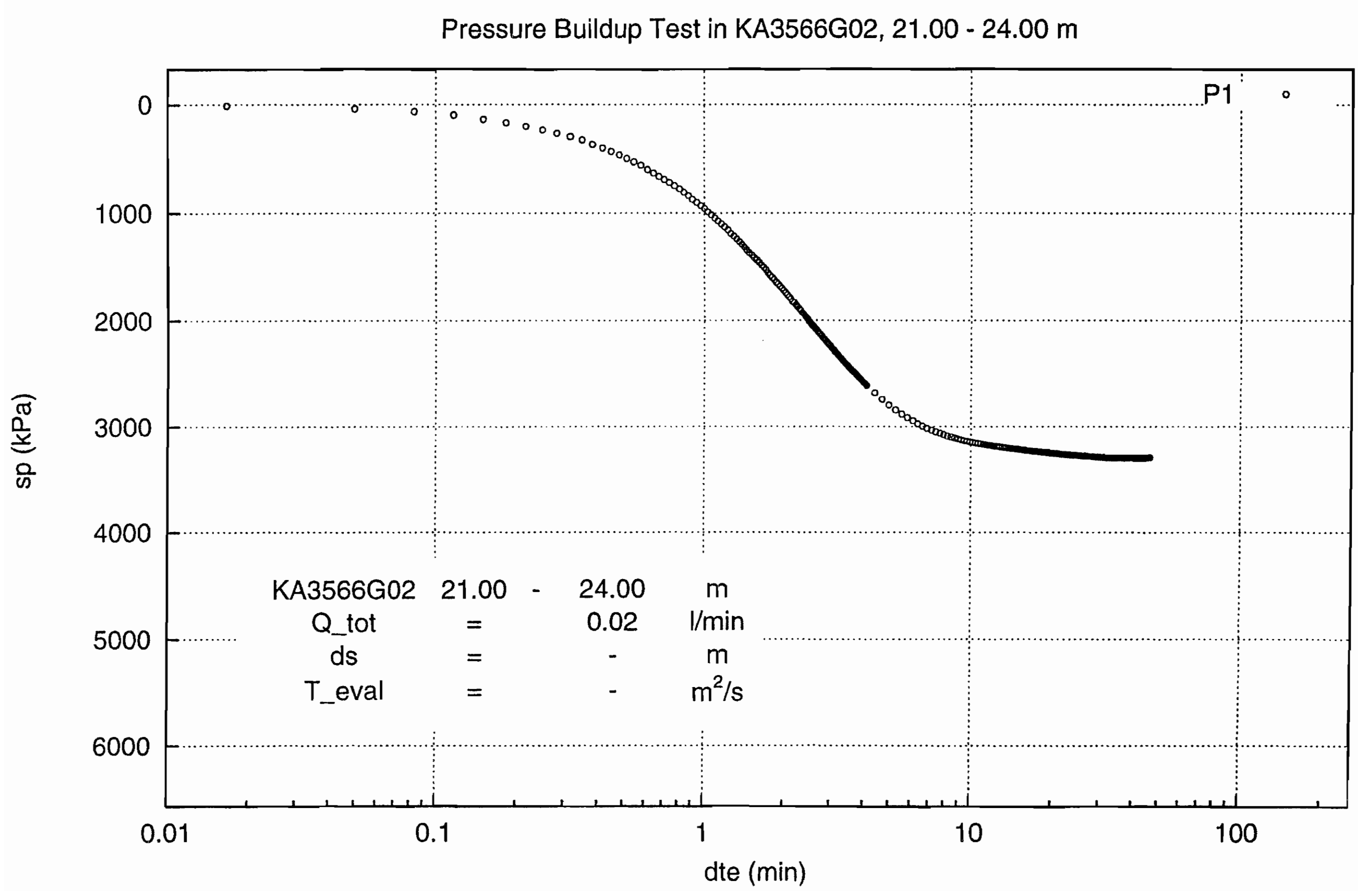
Pressure Buildup Test in KA3566G02, 15.00 - 18.00 m
P1
0
1000
2000
3000
4000
5000
6000
sp (kPa)
KA3566G02 15.00 - 18.00 m
Q_tot = 0.11 l/min
ds = 66.25 m
T_eval = 5.0E-09 m2/s
0.1
1
10
100
dte (min)

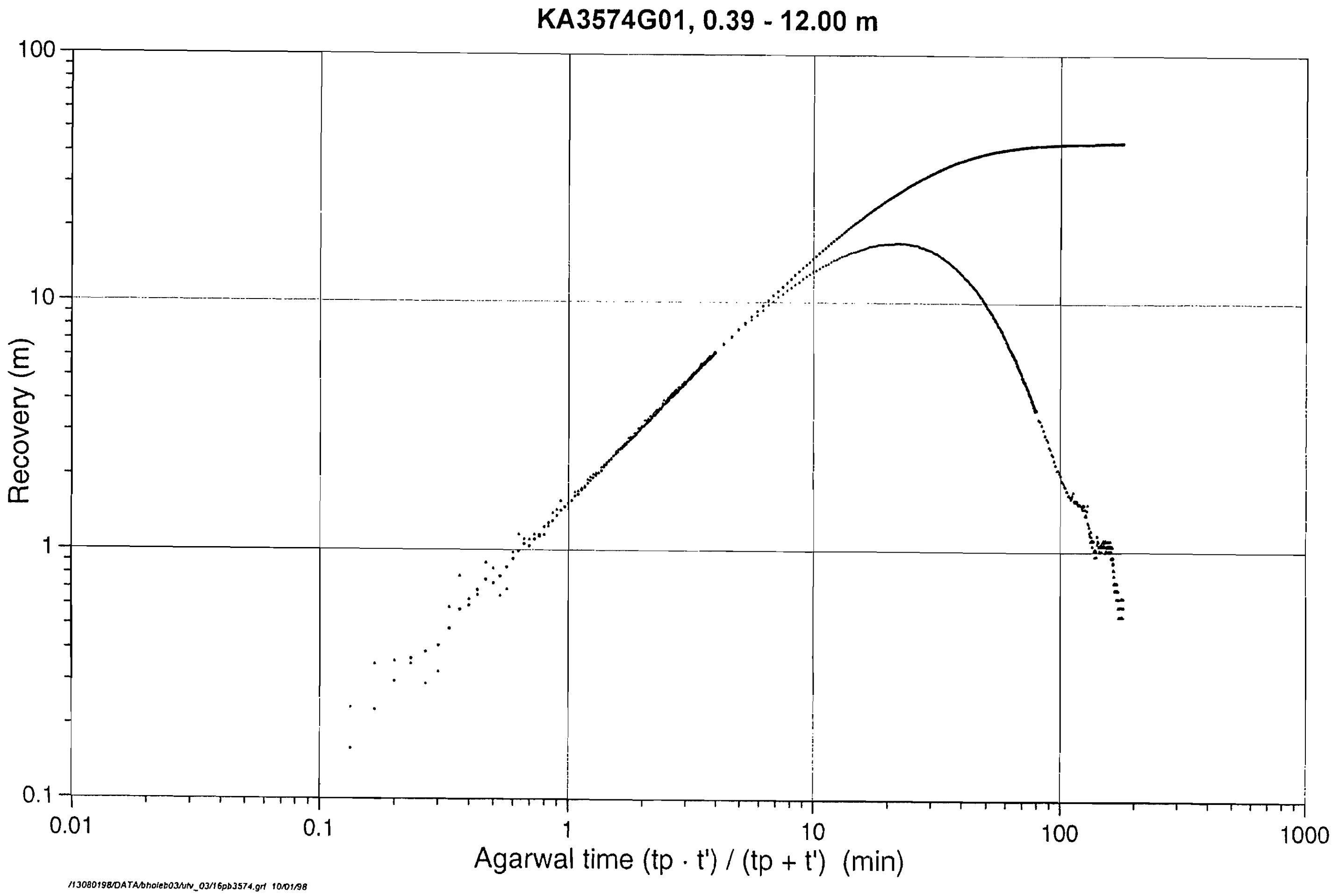




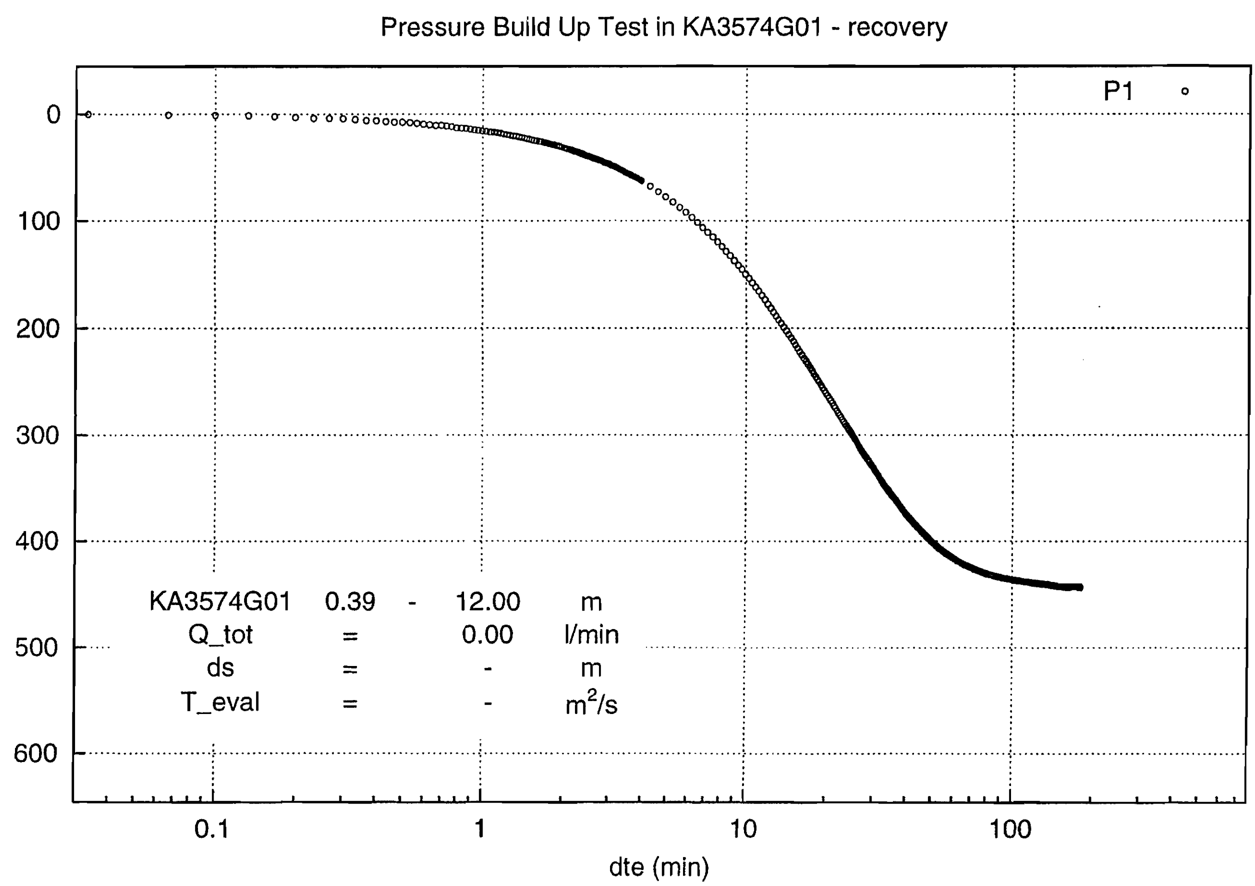
/13080198/DATA/bholeb03/utv_03/31pb3566.grf 04/22/99


Pressure Buildup Test in KA3566G02, 21.00 - 24.00 m
P1
sp (kPa)
1000
100
10
0.01
0.1
1
10
100
dte (min)

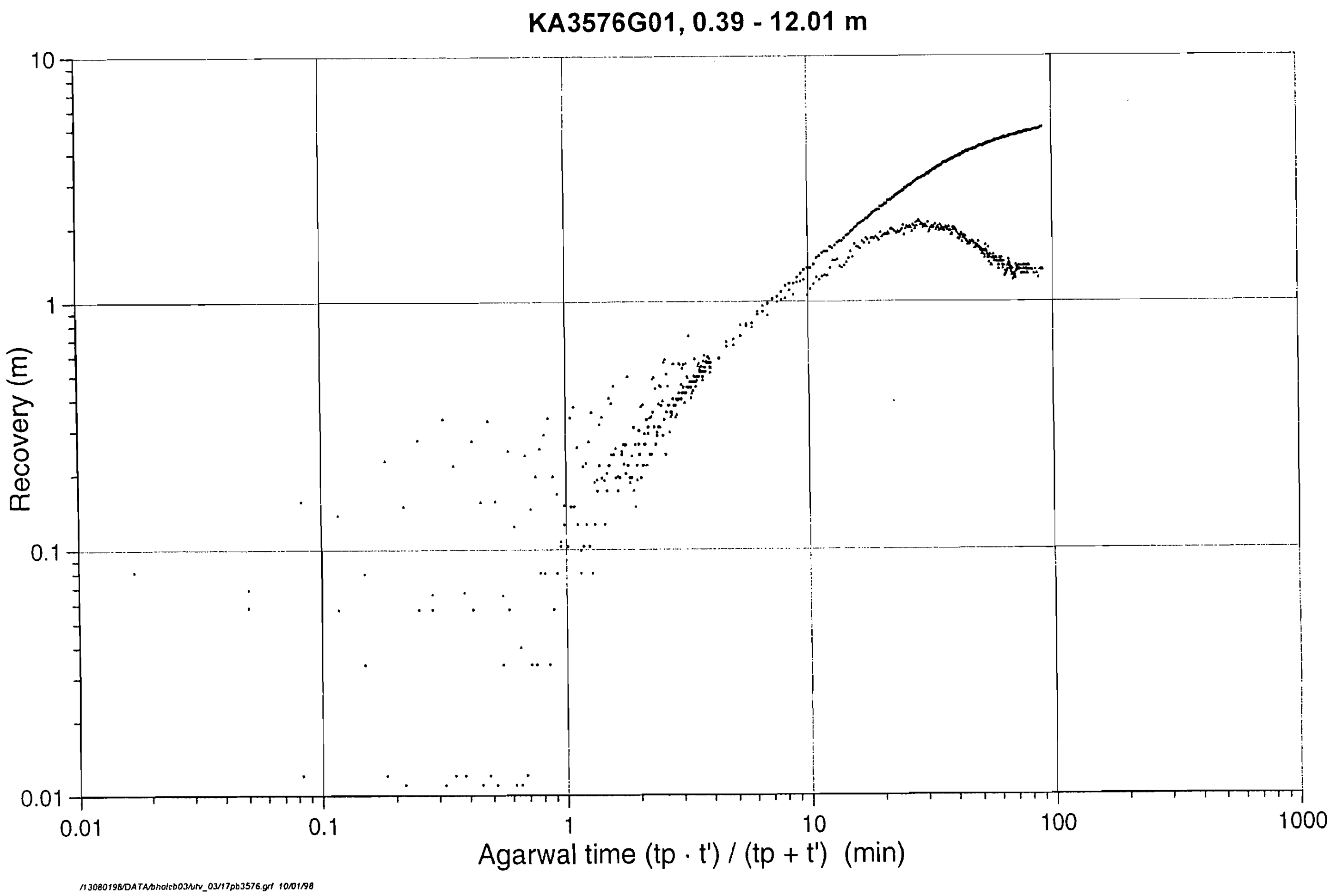

Pressure Buildup Test in KA3566G02, 21.00 - 24.00 m
P1
sp (kPa)
0
1000
2000
3000
4000
5000
6000
KA3566G02 21.00 - 24.00 m
Q_tot = 0.02 l/min
ds = - m
T_eval = - m2/s
0.01
0.1
1
10
100
dte (min)

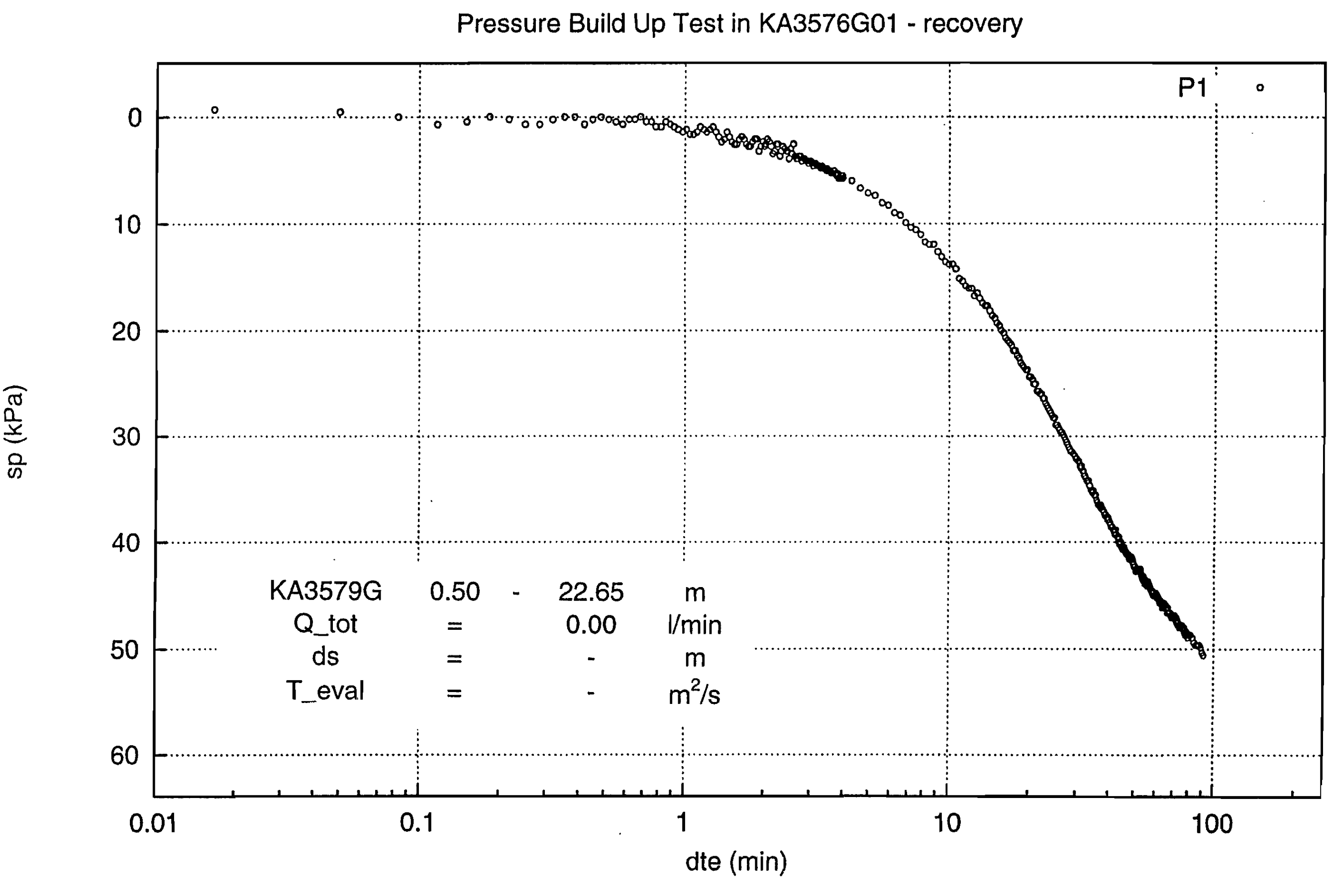


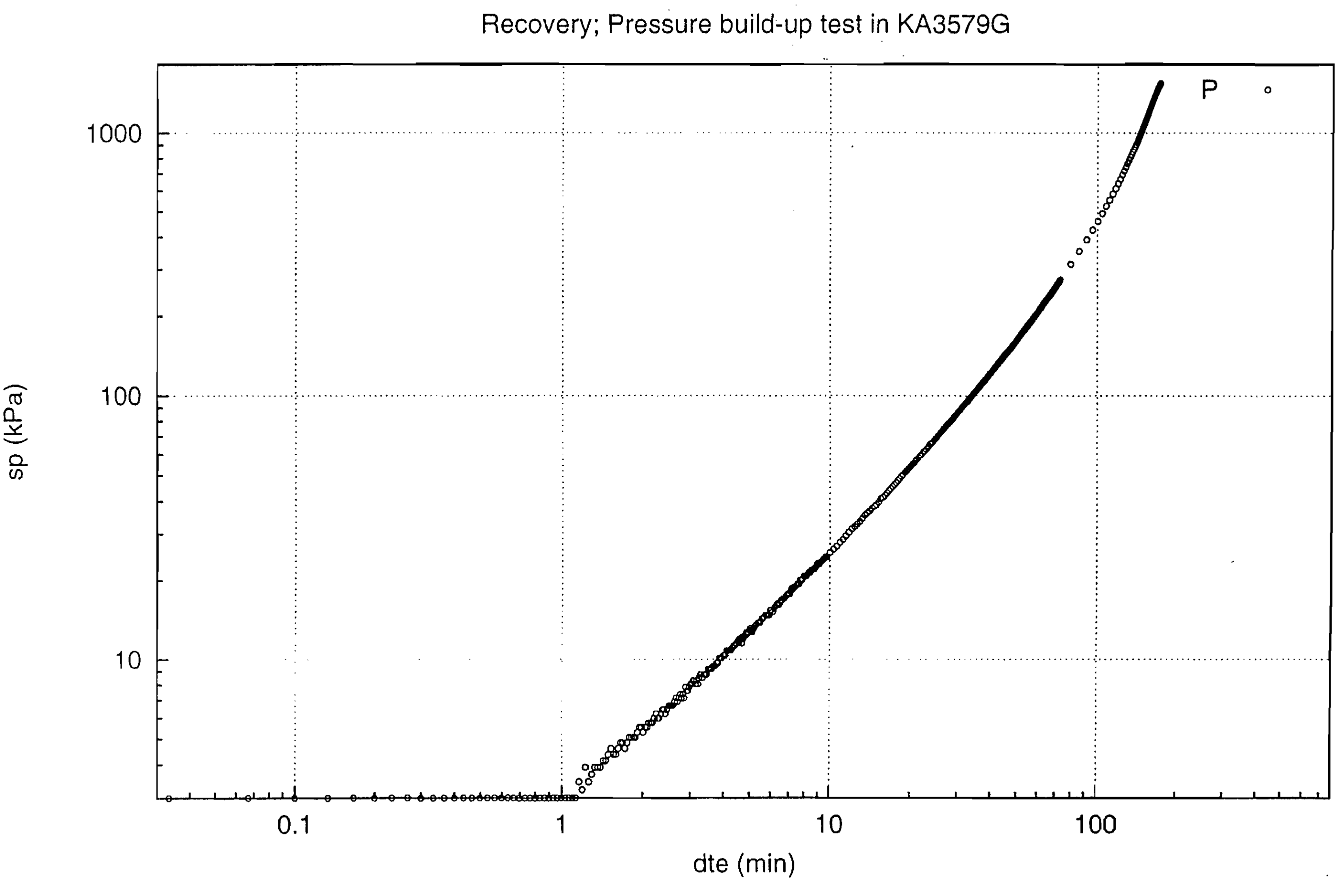
KA3574G01, 0.39 - 12.00 m
Recovery (m)
Agarwal time (tp - t') / (tp + t') (min)
100
10
1
0.1
0.01
0.1
1
10
100
1000
/13080198/DATA/bholeb03/utv_03/16pb3574.grf 10/01/98

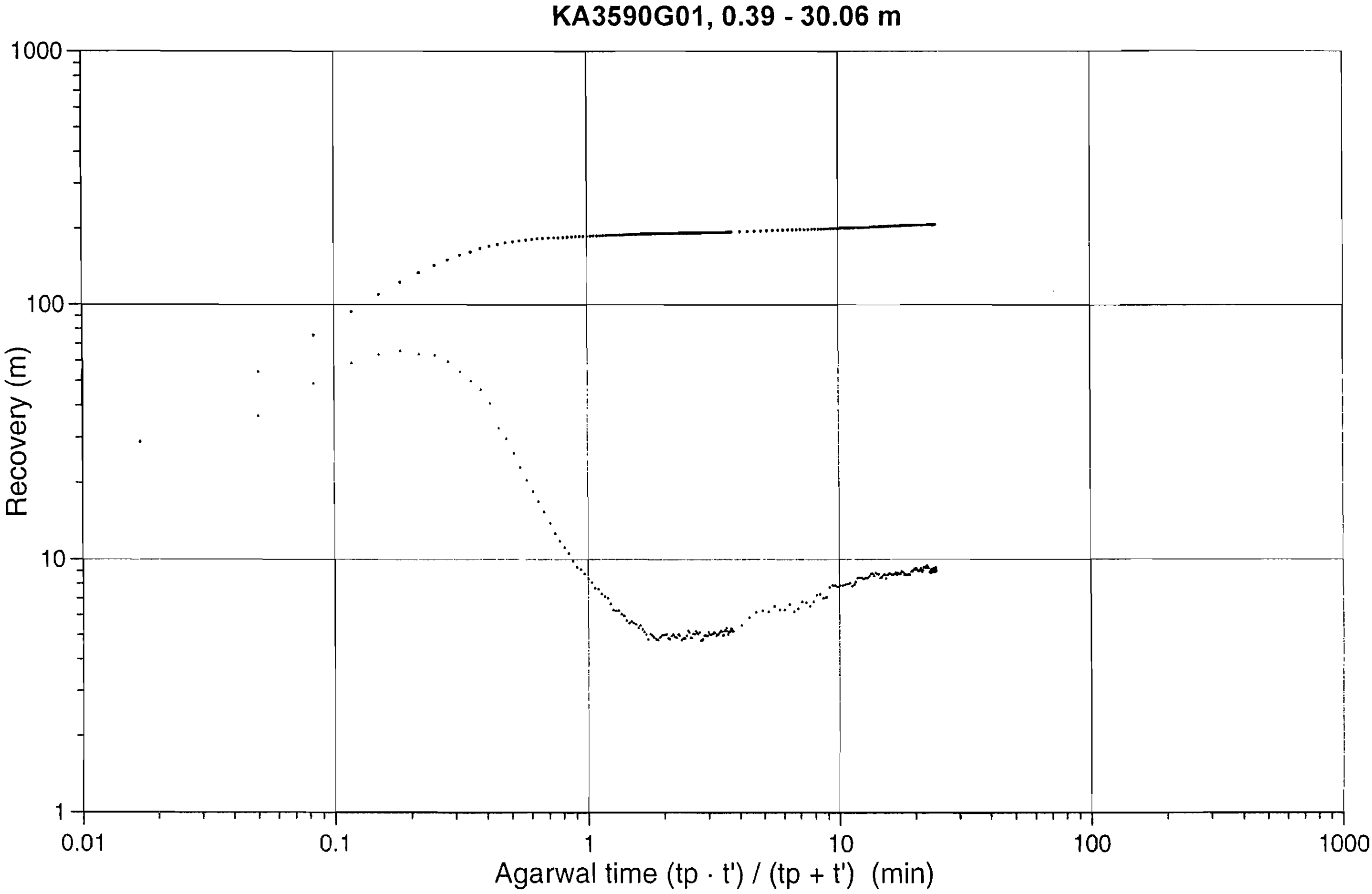


Pressure Build Up Test in KA3574G01 - recovery
P1
sp (kPa)
dte (min)
0
100
200
300
400
500
600
0.1
1
10
100
KA3574G01 0.39 - 12.00 m
Q_tot = 0.00 l/min
ds = - m
T_eval = - m²/s

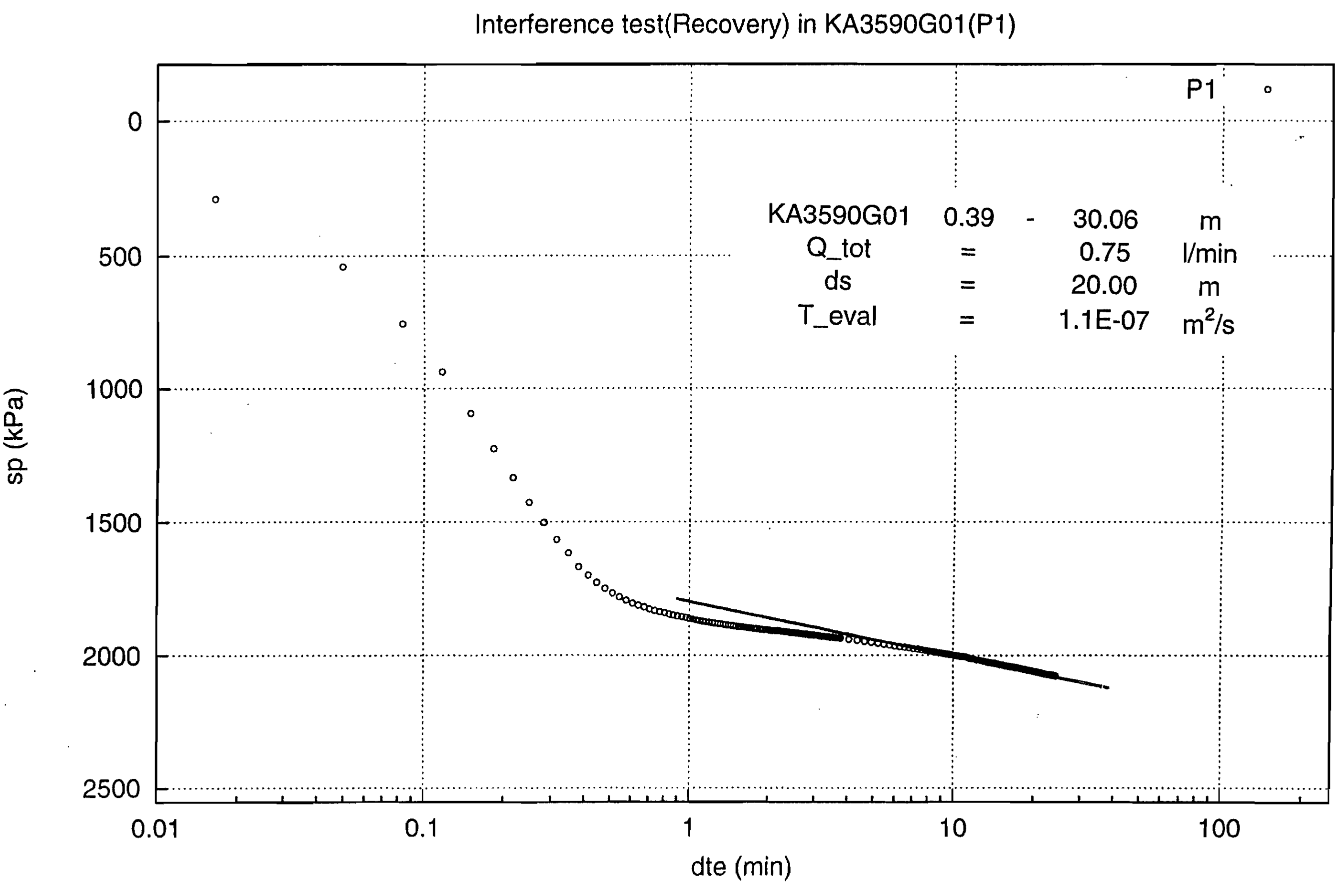

KA3576G01, 0.39 - 12.01 m
Recovery (m)
Agarwal time (tp · t') / (tp + t') (min)
10
1
0.1
0.01
0.01
0.1
1
10
100
1000

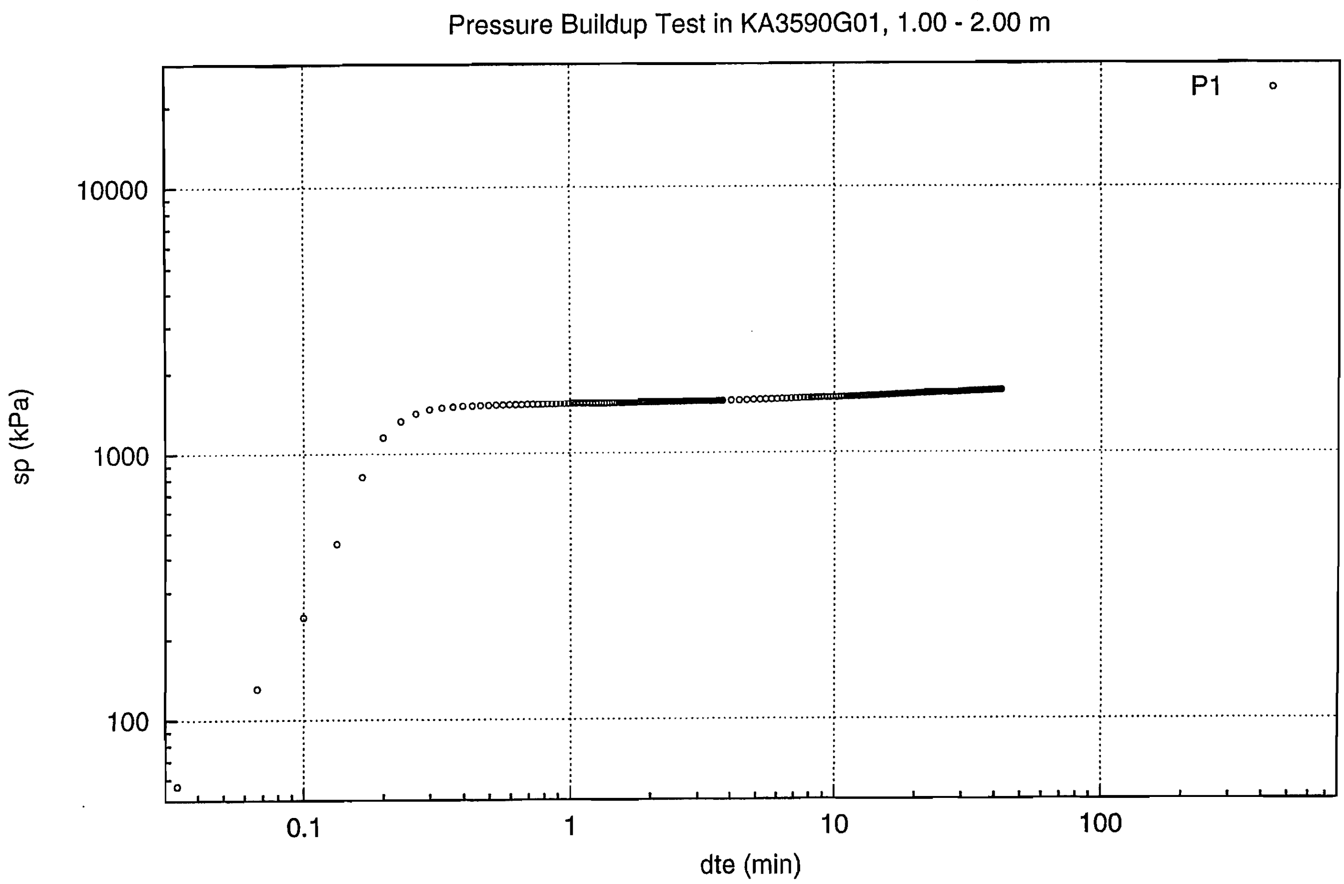

Pressure Build Up Test in KA3576G01 - recovery
P1
sp (kPa)
dte (min)
KA3579G 0.50 - 22.65 m
Q_tot = 0.00 l/min
ds = - m
T_eval = - m²/s

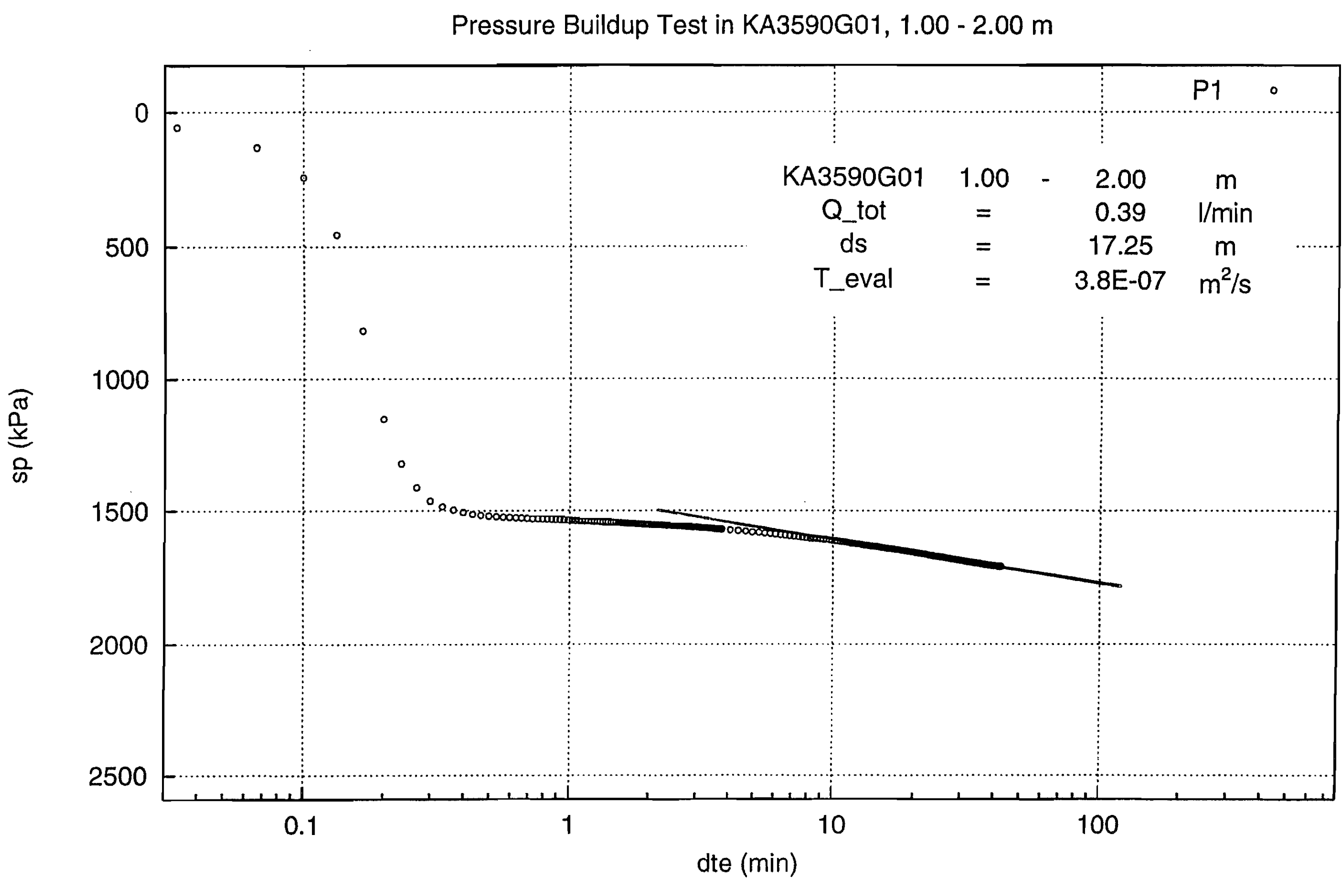

Recovery; Pressure build-up test in KA3579G
P
1000
100
10
sp (kPa)
0.1
1
10
100
dte (min)

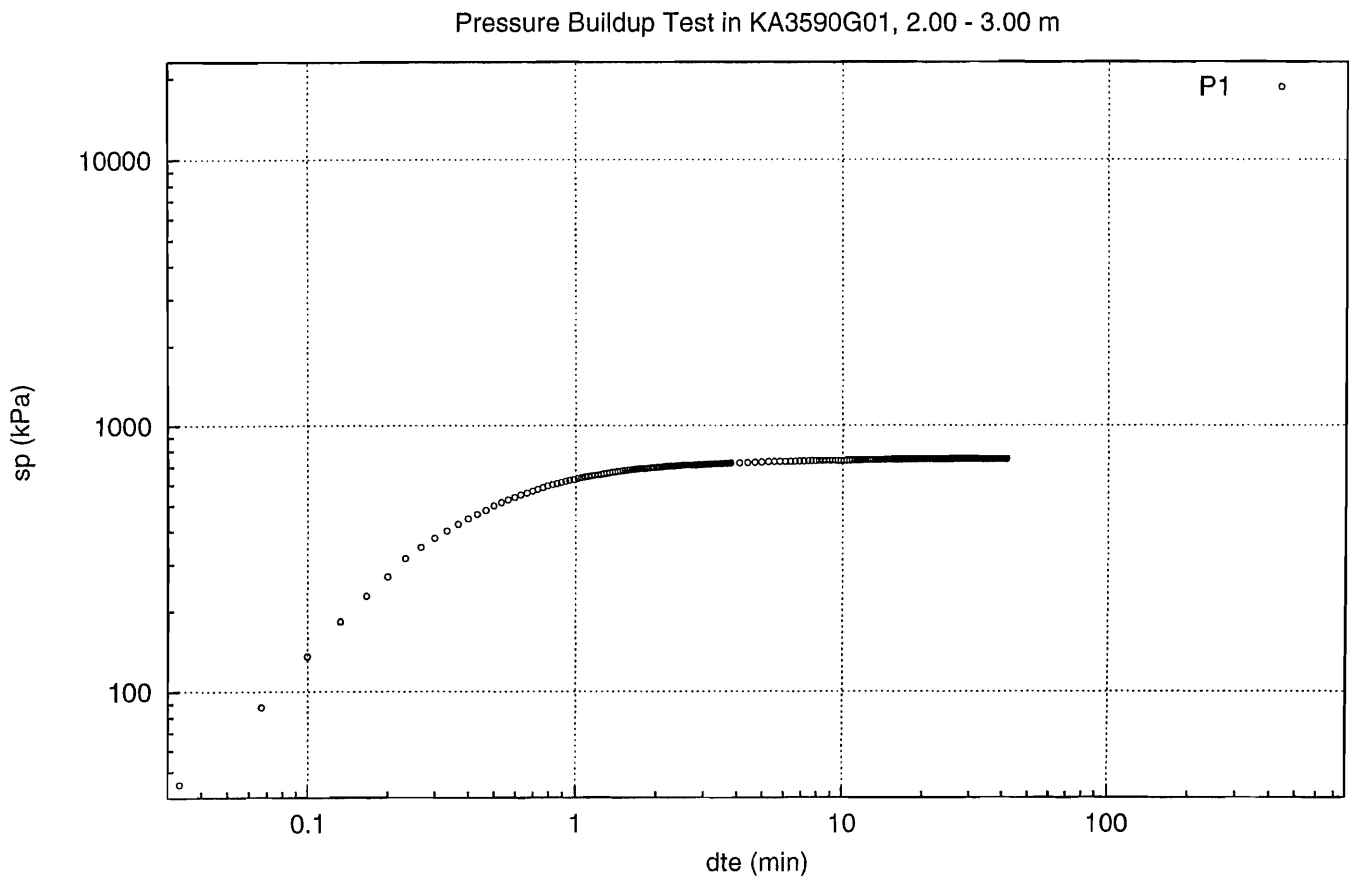


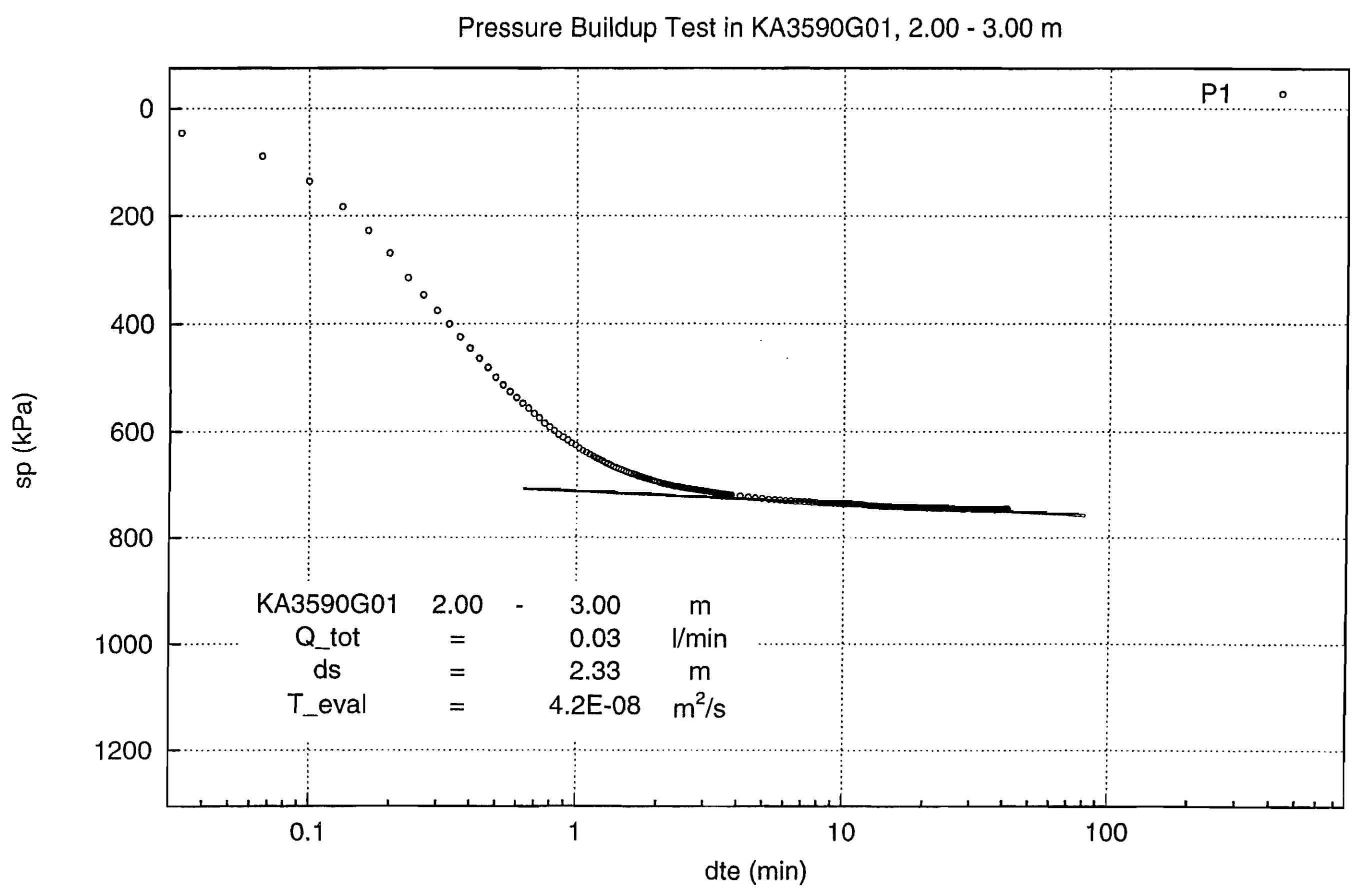
/13080198/DATA/bhole03/utv_03/06pb3590.grf 10/01/98

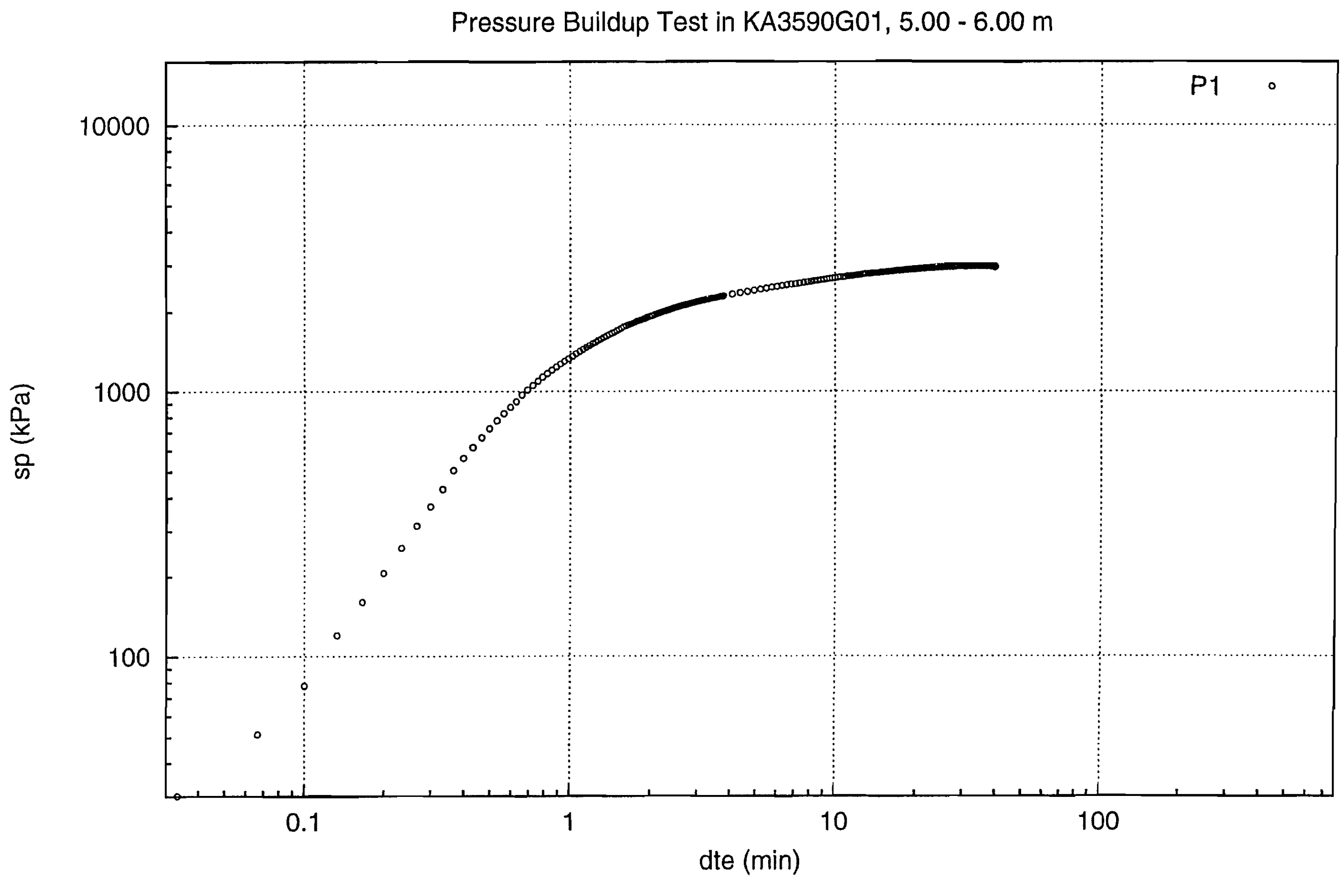



Pressure Buildup Test in KA3590G01, 1.00 - 2.00 m
P1
10000
1000
100
sp (kPa)
0.1
1
10
100
dte (min)

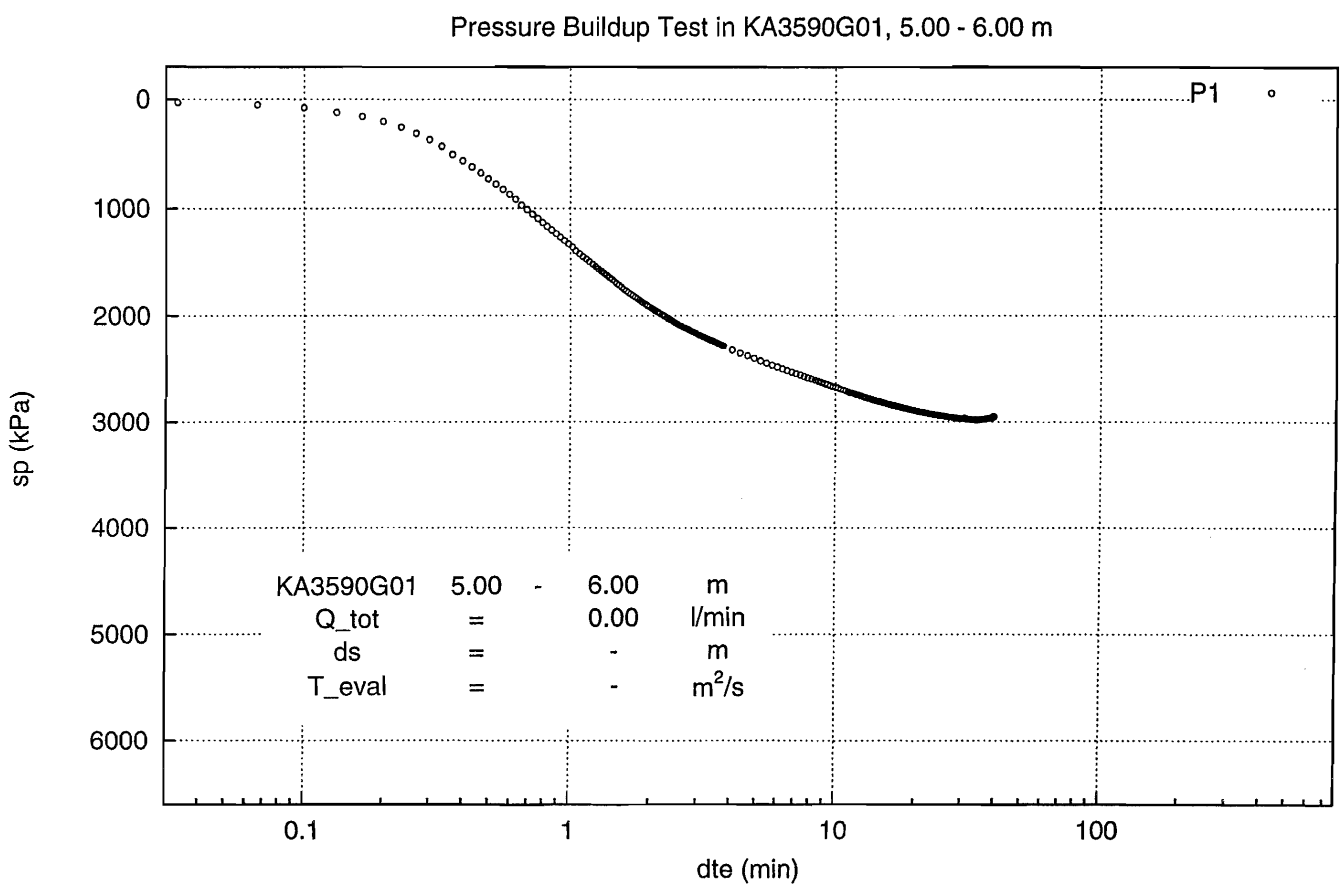

Pressure Buildup Test in KA3590G01, 1.00 - 2.00 m
P1
KA3590G01 1.00 - 2.00 m
Q_tot = 0.39 l/min
ds = 17.25 m
T_eval = 3.8E-07 m2/s
0
500
1000
1500
2000
2500
sp (kPa)
0.1
1
10
100
dte (min)


Pressure Buildup Test in KA3590G01, 2.00 - 3.00 m
P1
10000
1000
100
sp (kPa)
0.1
1
10
100
dte (min)

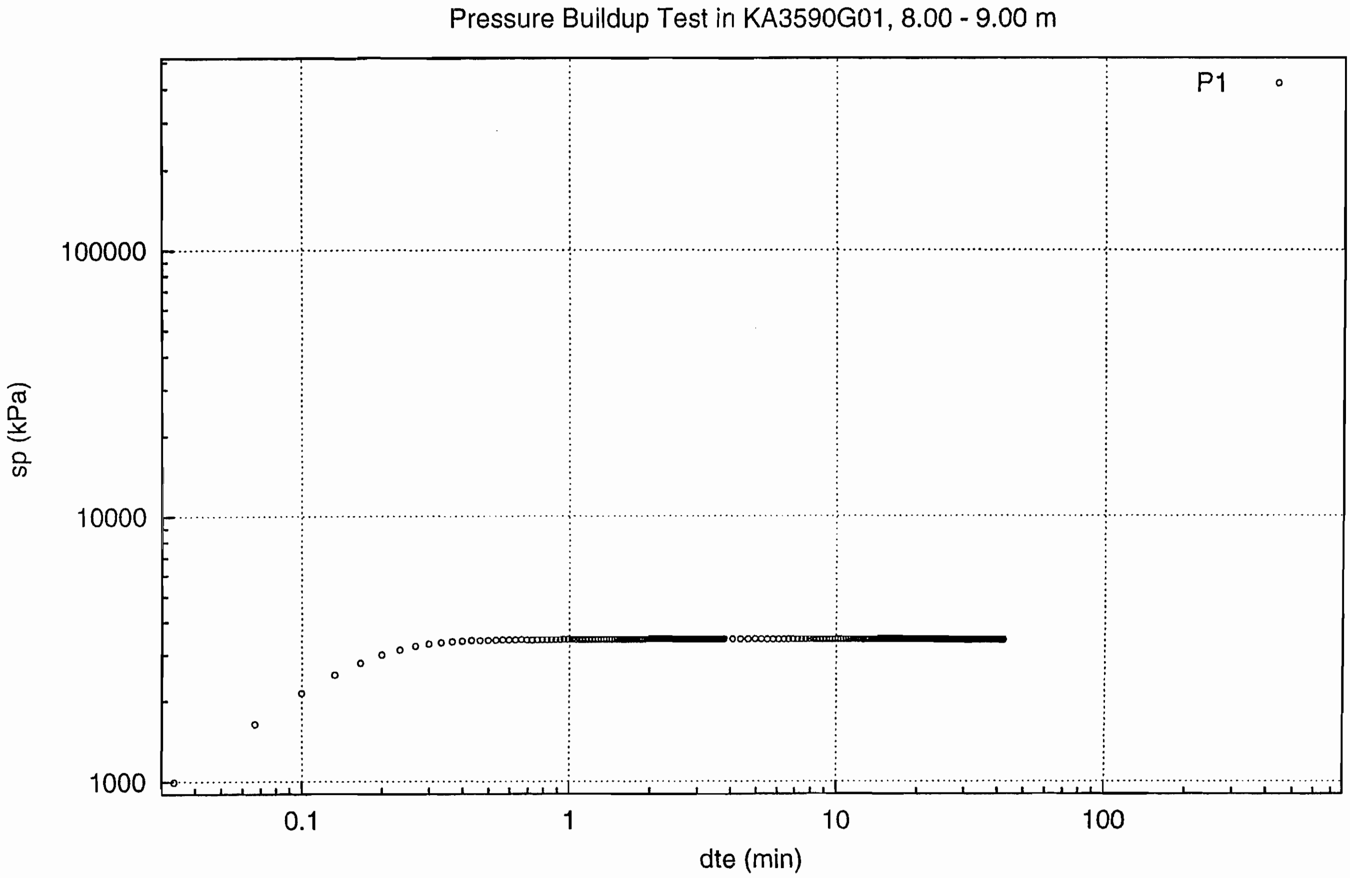

Pressure Buildup Test in KA3590G01, 2.00 - 3.00 m
P1
0
200
400
600
800
1000
1200
sp (kPa)
KA3590G01 2.00 - 3.00 m
Q_tot = 0.03 l/min
ds = 2.33 m
T_eval = 4.2E-08 m²/s
0.1
1
10
100
dte (min)



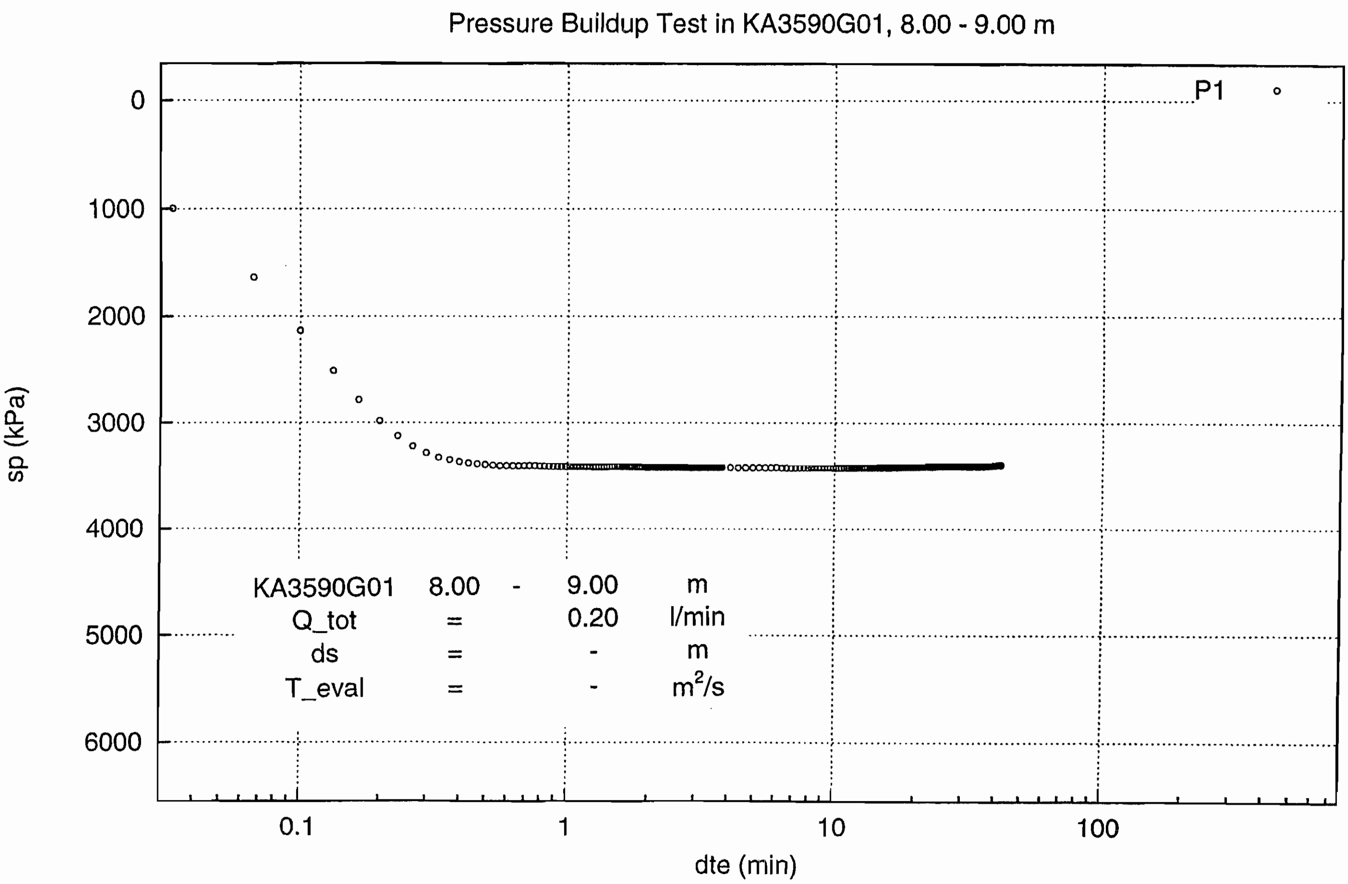
Pressure Buildup Test in KA3590G01, 5.00 - 6.00 m
P1
10000
1000
100
sp (kPa)
0.1
1
10
100
dte (min)



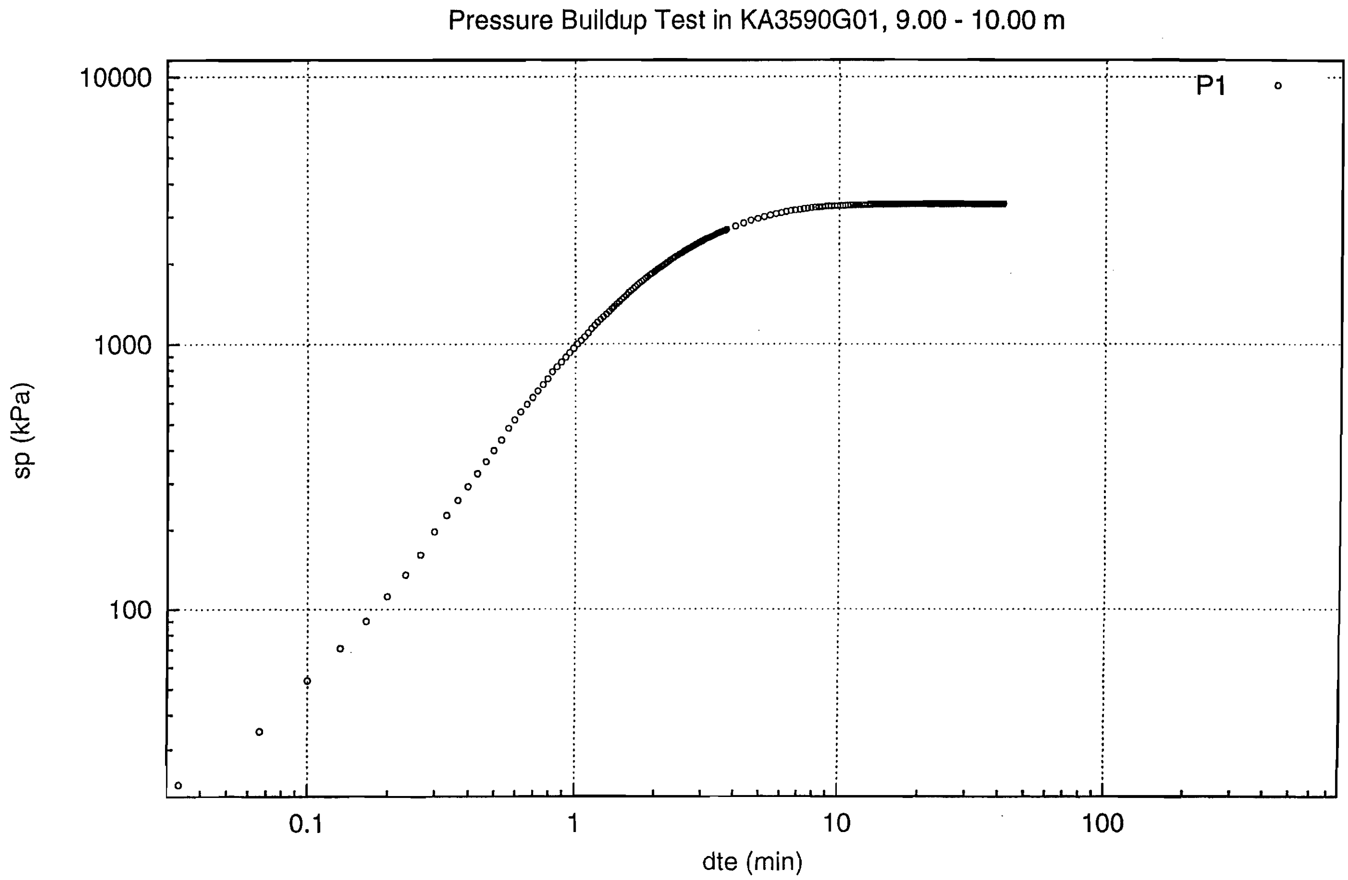
Pressure Buildup Test in KA3590G01, 5.00 - 6.00 m
P1
0
1000
2000
3000
4000
5000
6000
sp (kPa)
KA3590G01 5.00 - 6.00 m
Q_tot = 0.00 l/min
ds = - m
T_eval = - m²/s
0.1
1
10
100
dte (min)

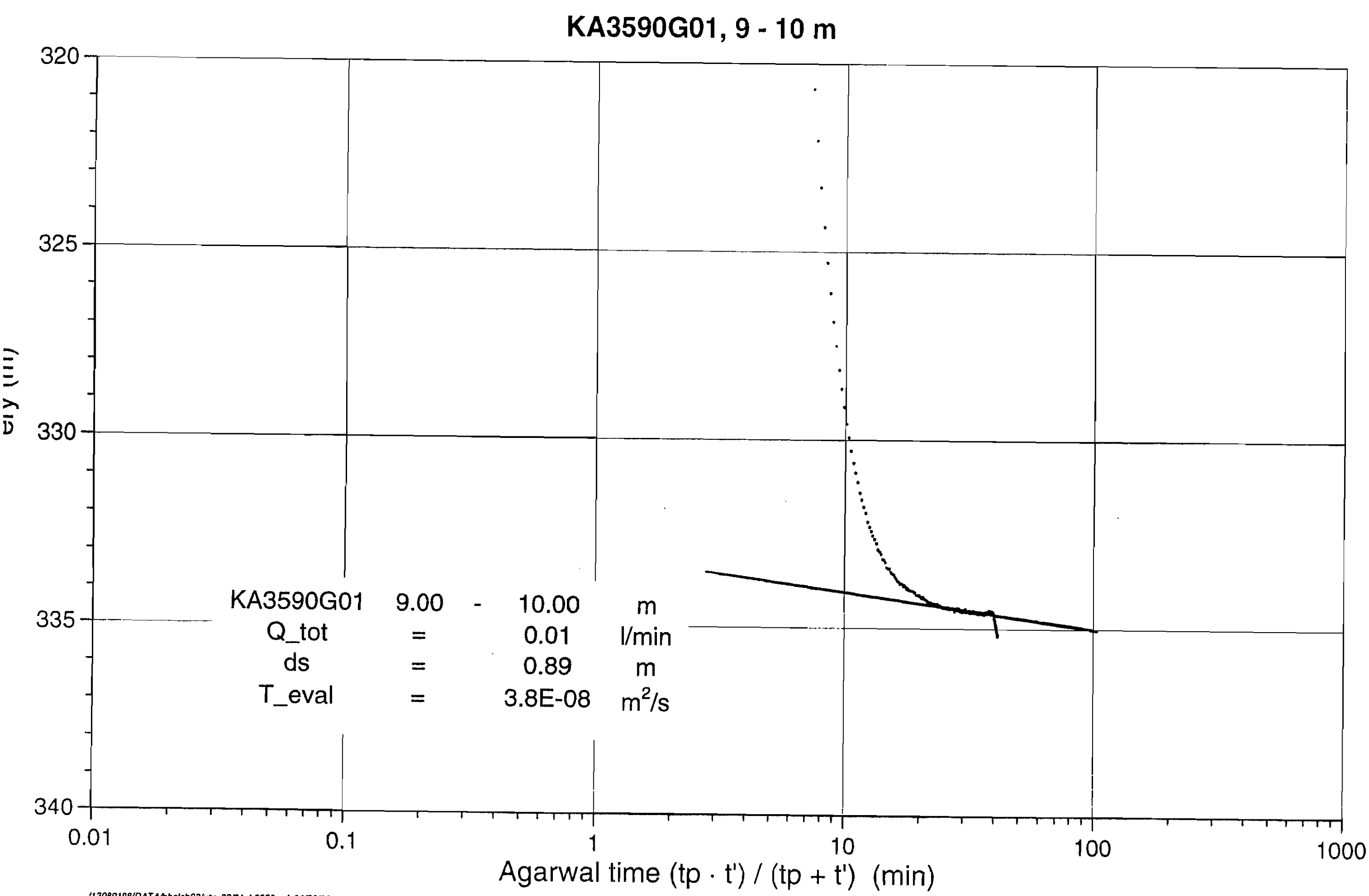


Pressure Buildup Test in KA3590G01, 8.00 - 9.00 m
P1
sp (kPa)
100000
10000
1000
0.1
1
10
100
dte (min)



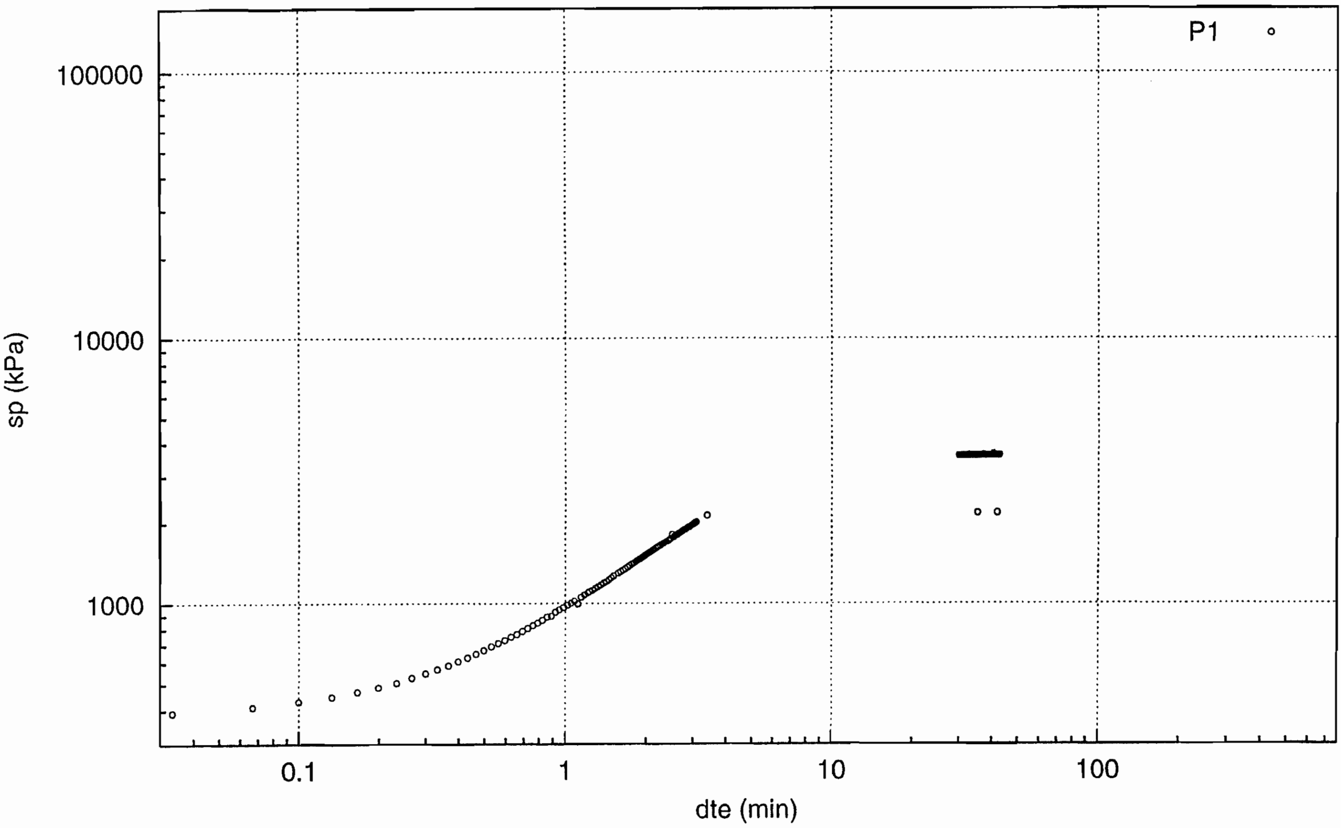
Pressure Buildup Test in KA3590G01, 8.00 - 9.00 m
P1
sp (kPa)
0
1000
2000
3000
4000
5000
6000
KA3590G01 8.00 - 9.00 m
Q_tot = 0.20 l/min
ds = - m
T_eval = - m²/s
0.1
1
10
100
dte (min)



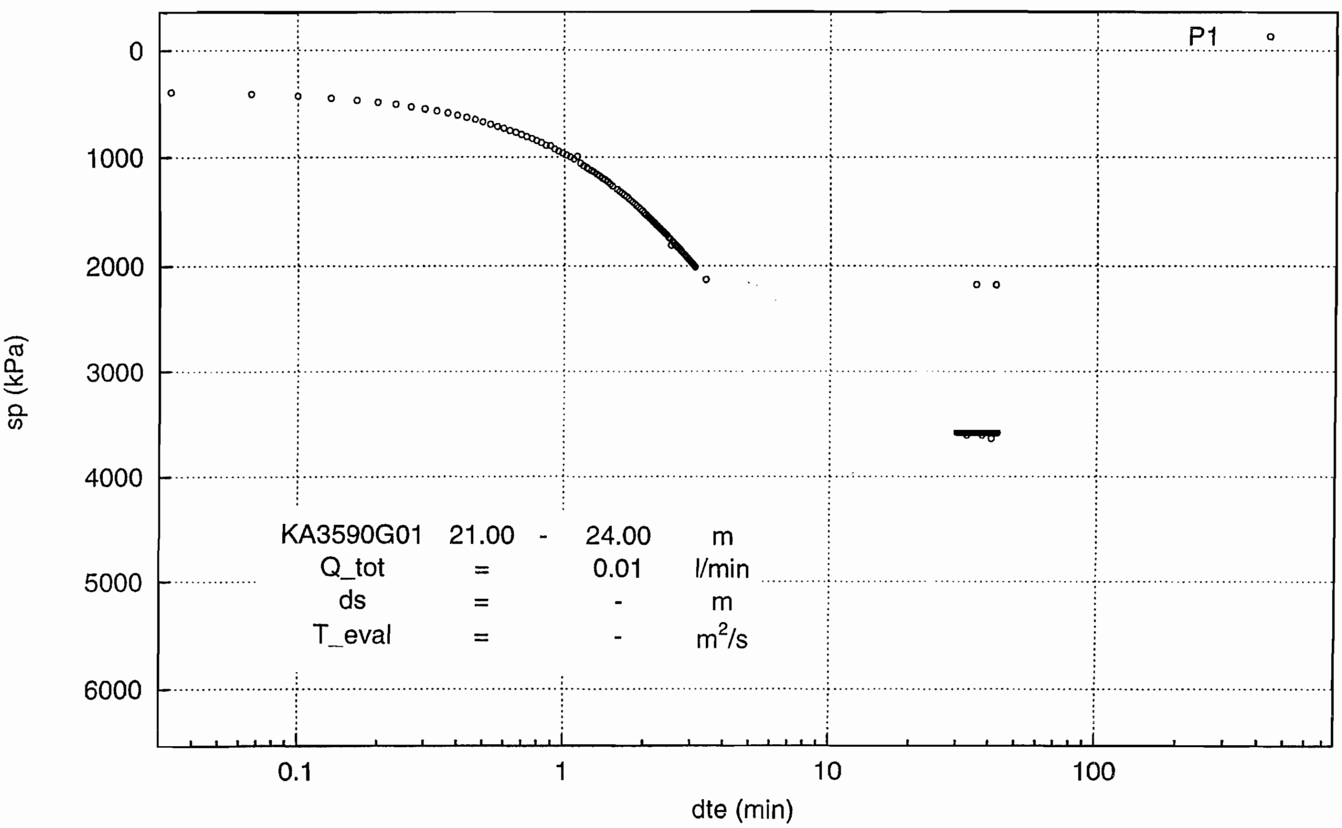


/13080198/DATA/bholeb03/utv_03/24pb3590.grf 04/22/99

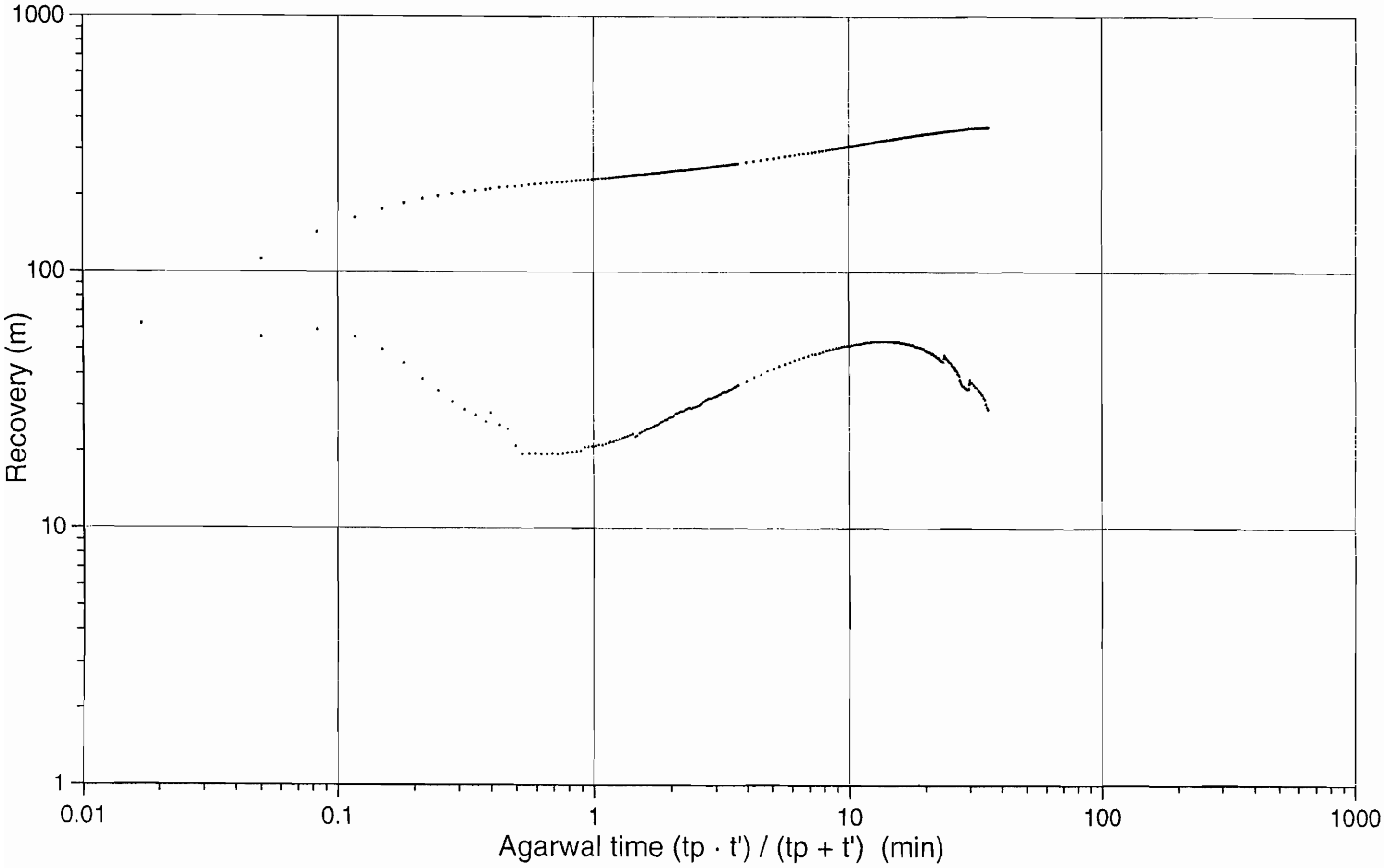
Pressure Buildup Test in KA3590G01, 21.00 - 24.00 m



Pressure Buildup Test in KA3590G01, 21.00 - 24.00 m

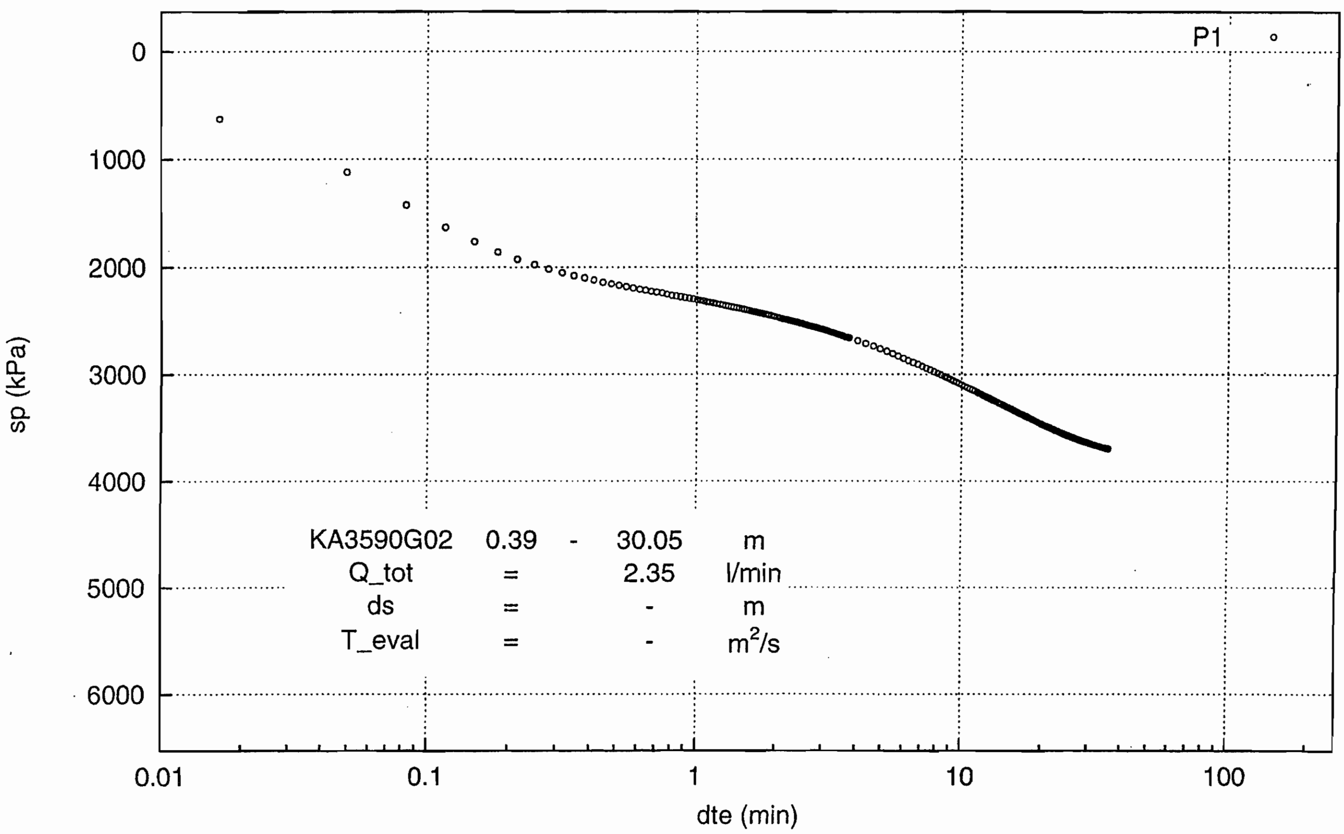


KA3590G02, 0.39 - 30.05 m

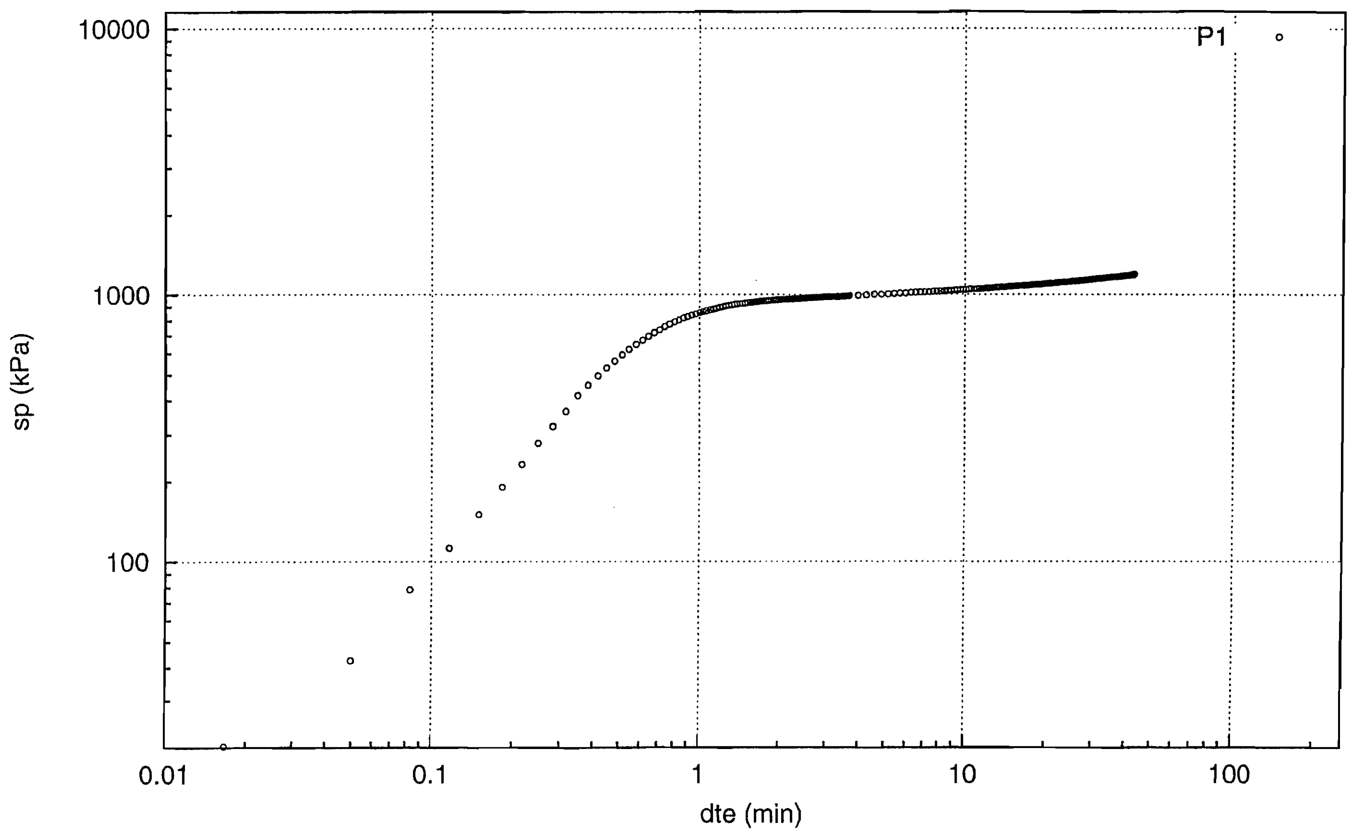


/13080198/DATA/bholeb03/utv_03/05pb3590.grf 10/01/98

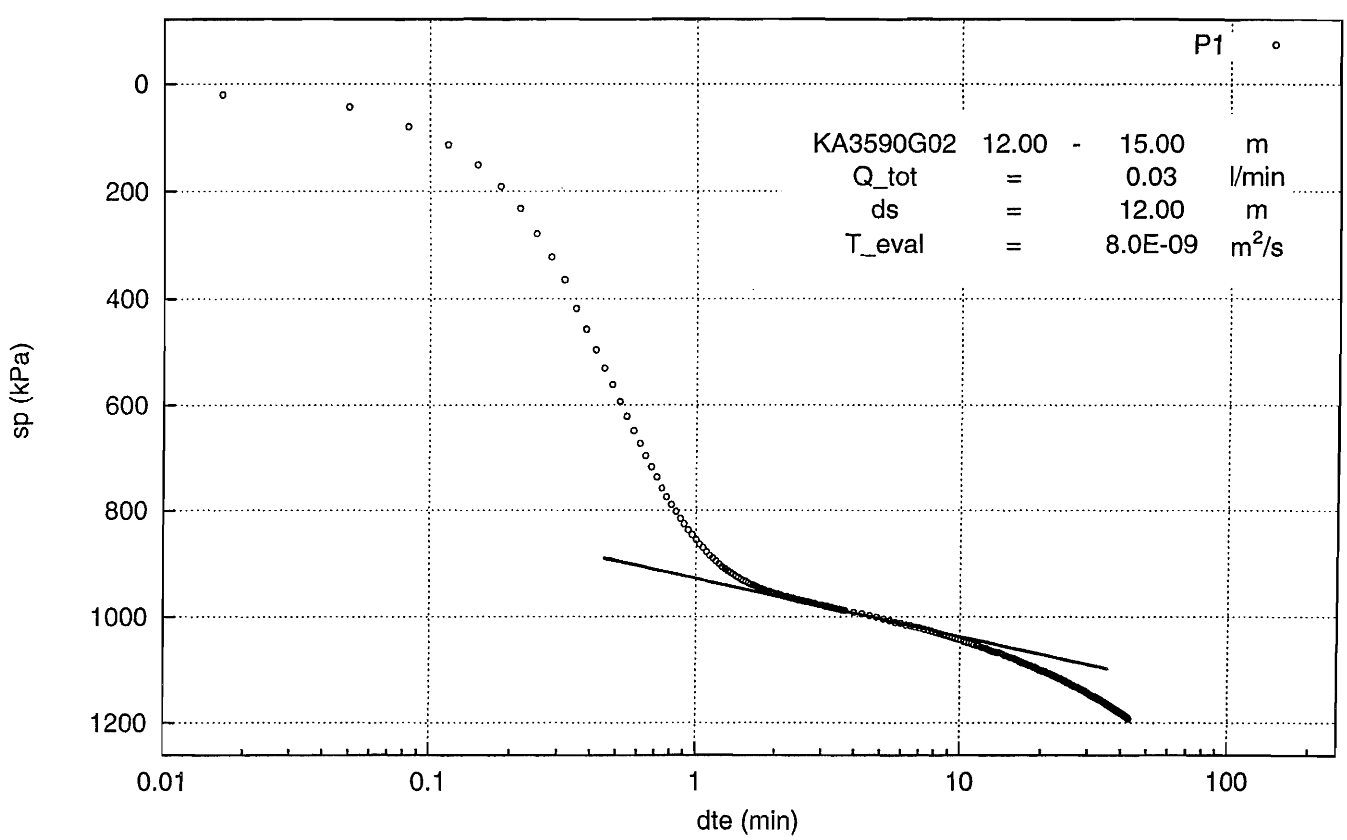
Interference test(recovery) in KA3590G02(P1)



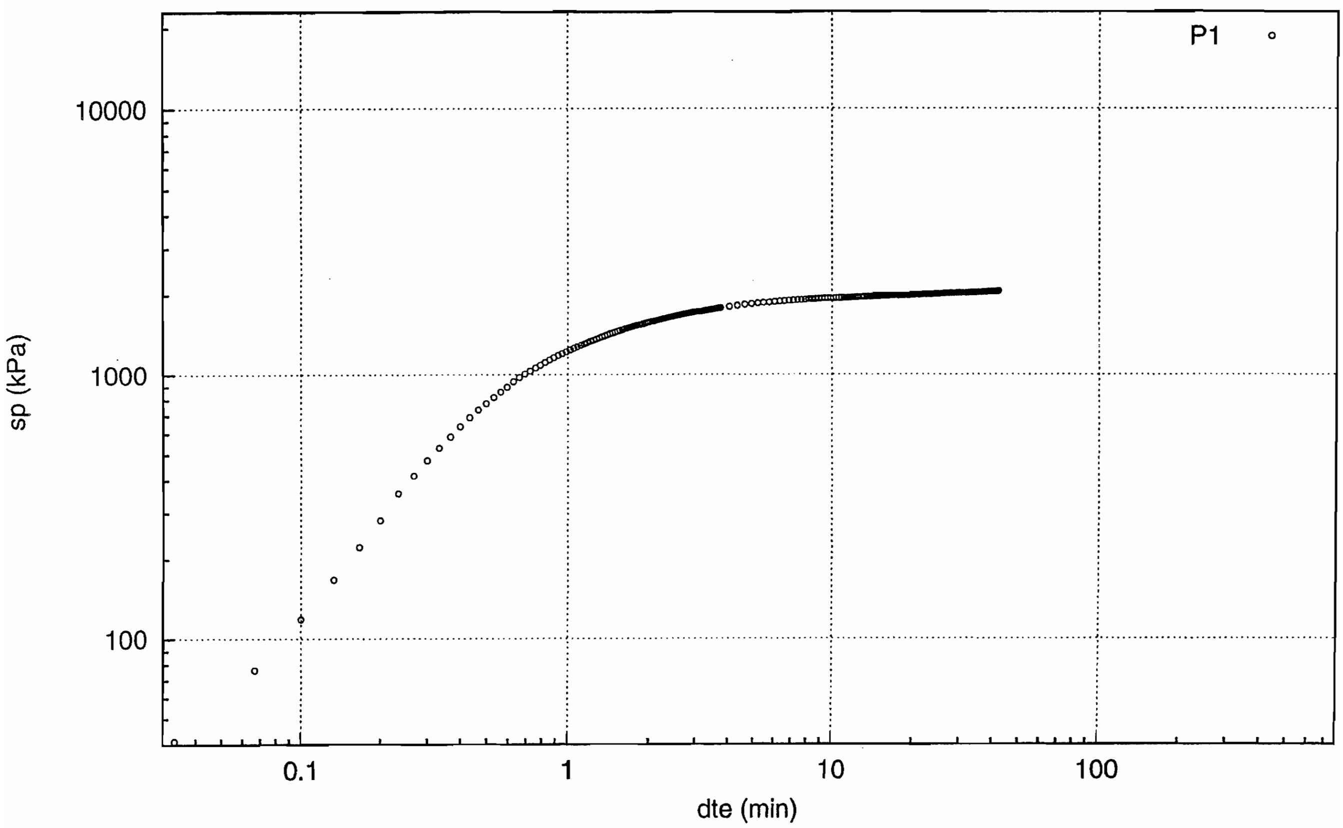
Pressure Buildup Test in KA3590G02, 12.00-15.00 m



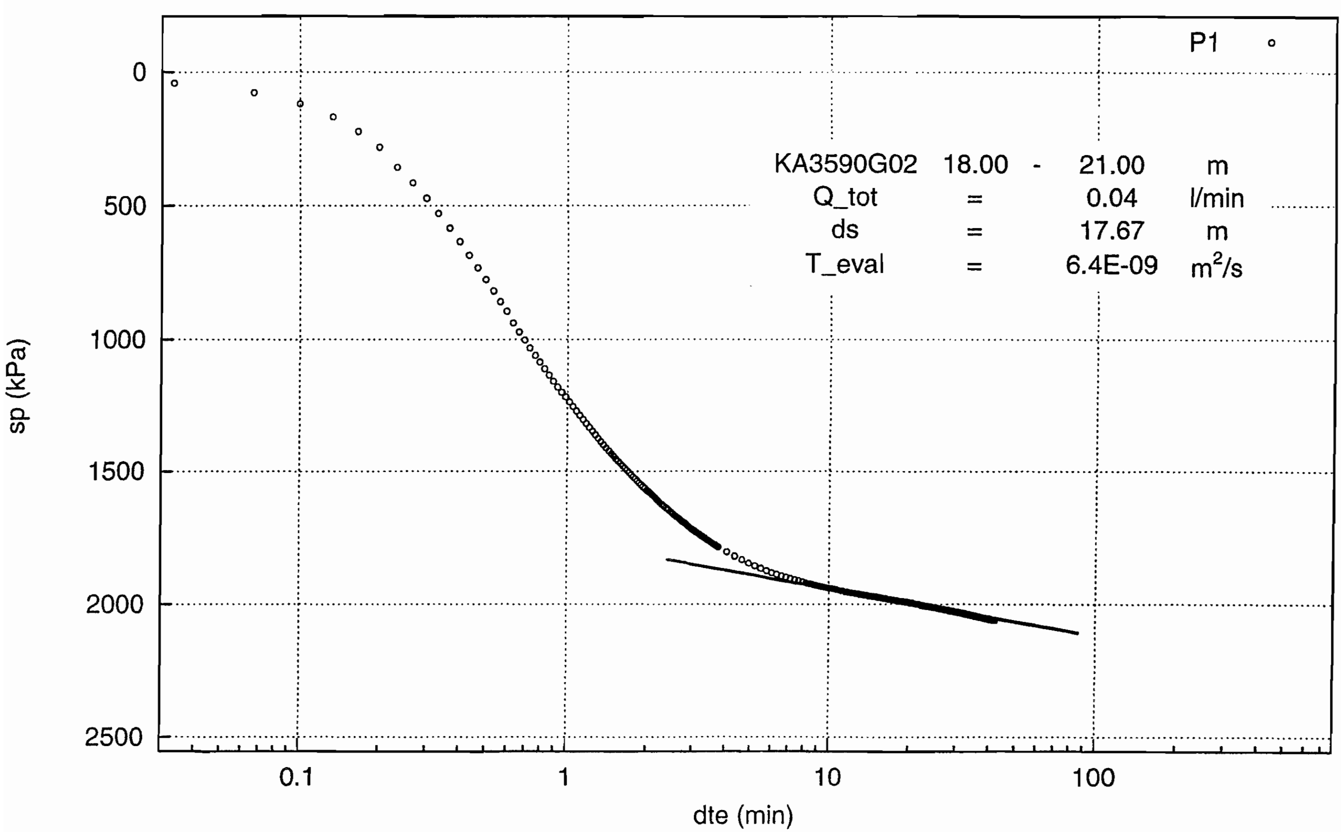
Pressure Buildup Test in KA3590G02, 12.00-15.00 m



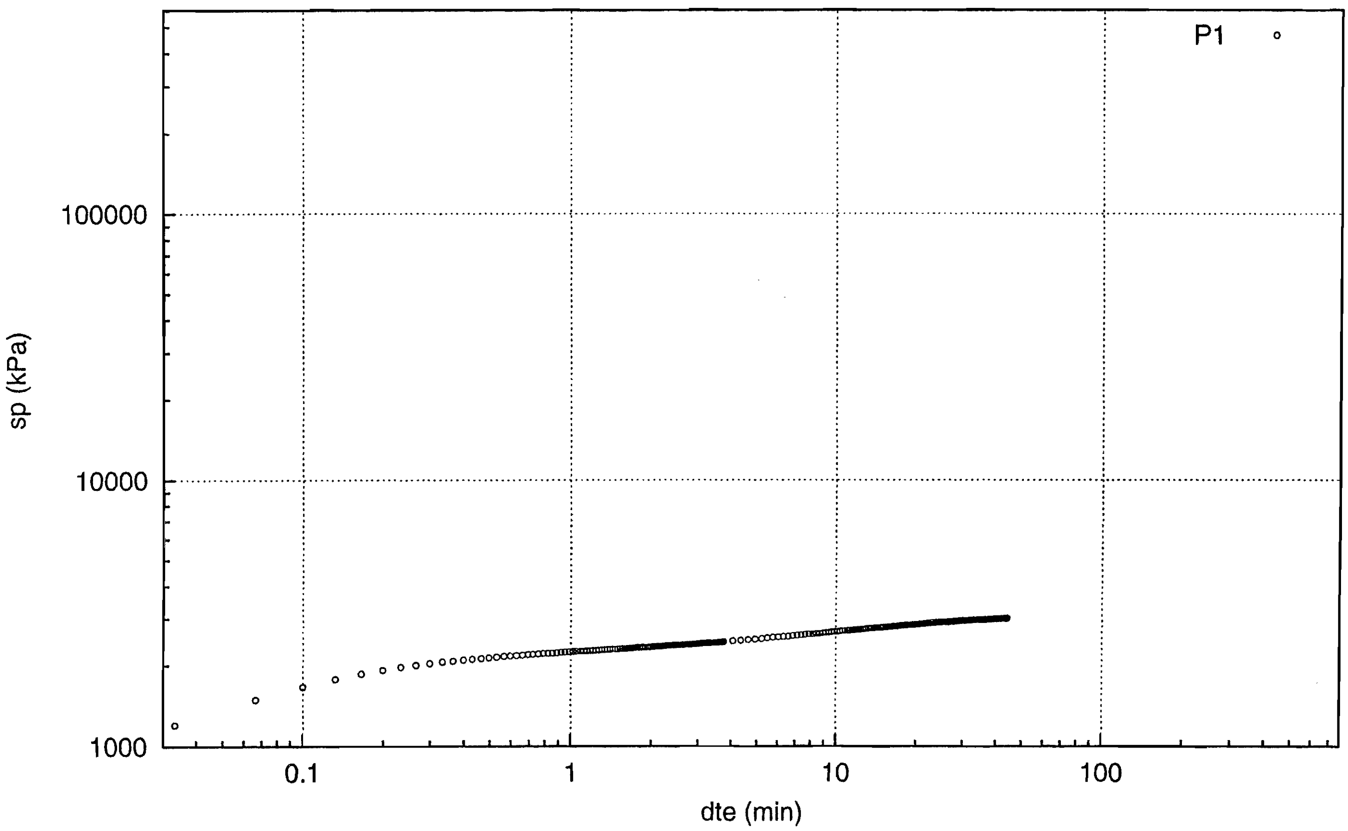
Pressure Buildup Test in KA3590G02, 18.00-21.00 m



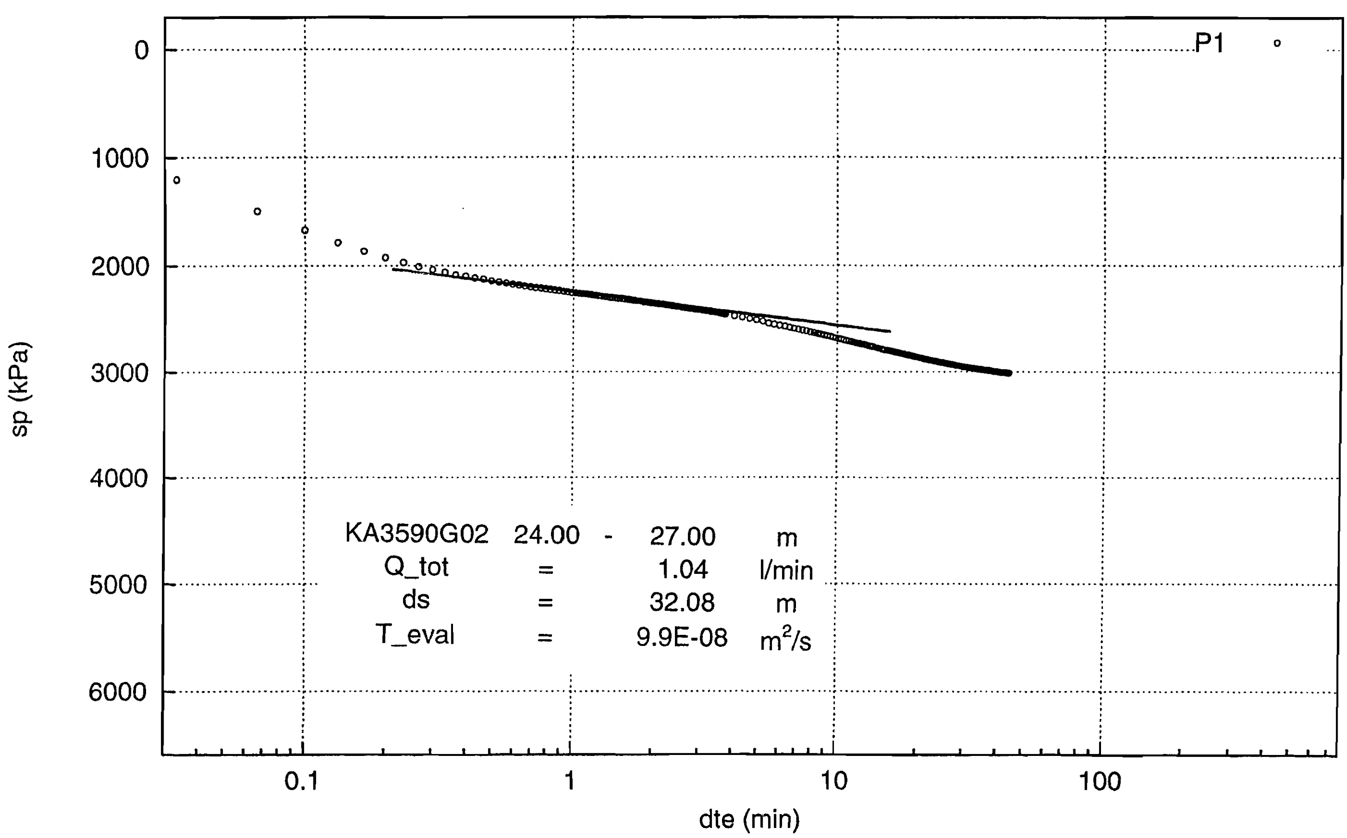
Pressure Buildup Test in KA3590G02, 18.00-21.00 m

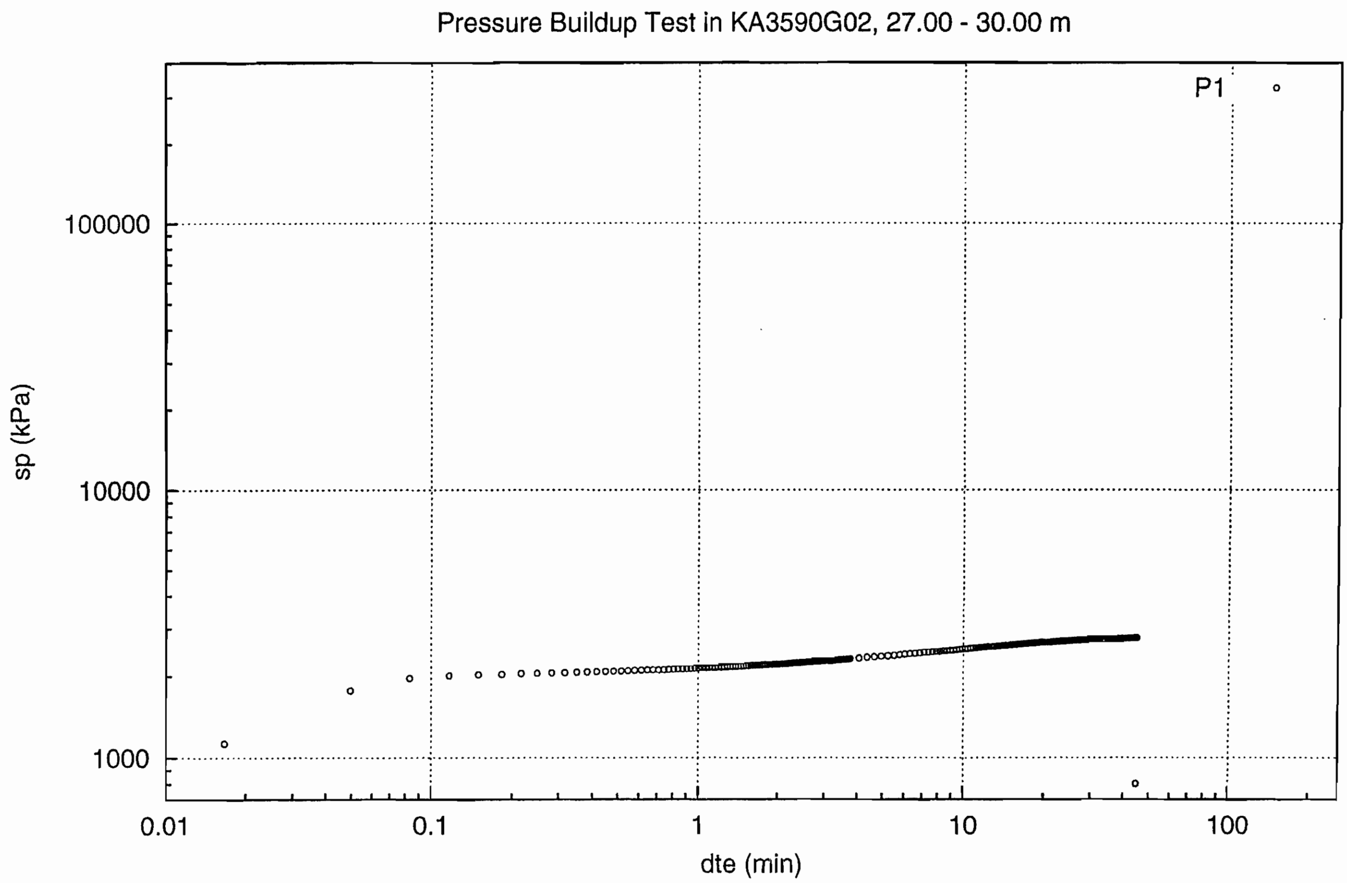


Pressure Buildup Test in KA3590G02, 24.00-27.00 m

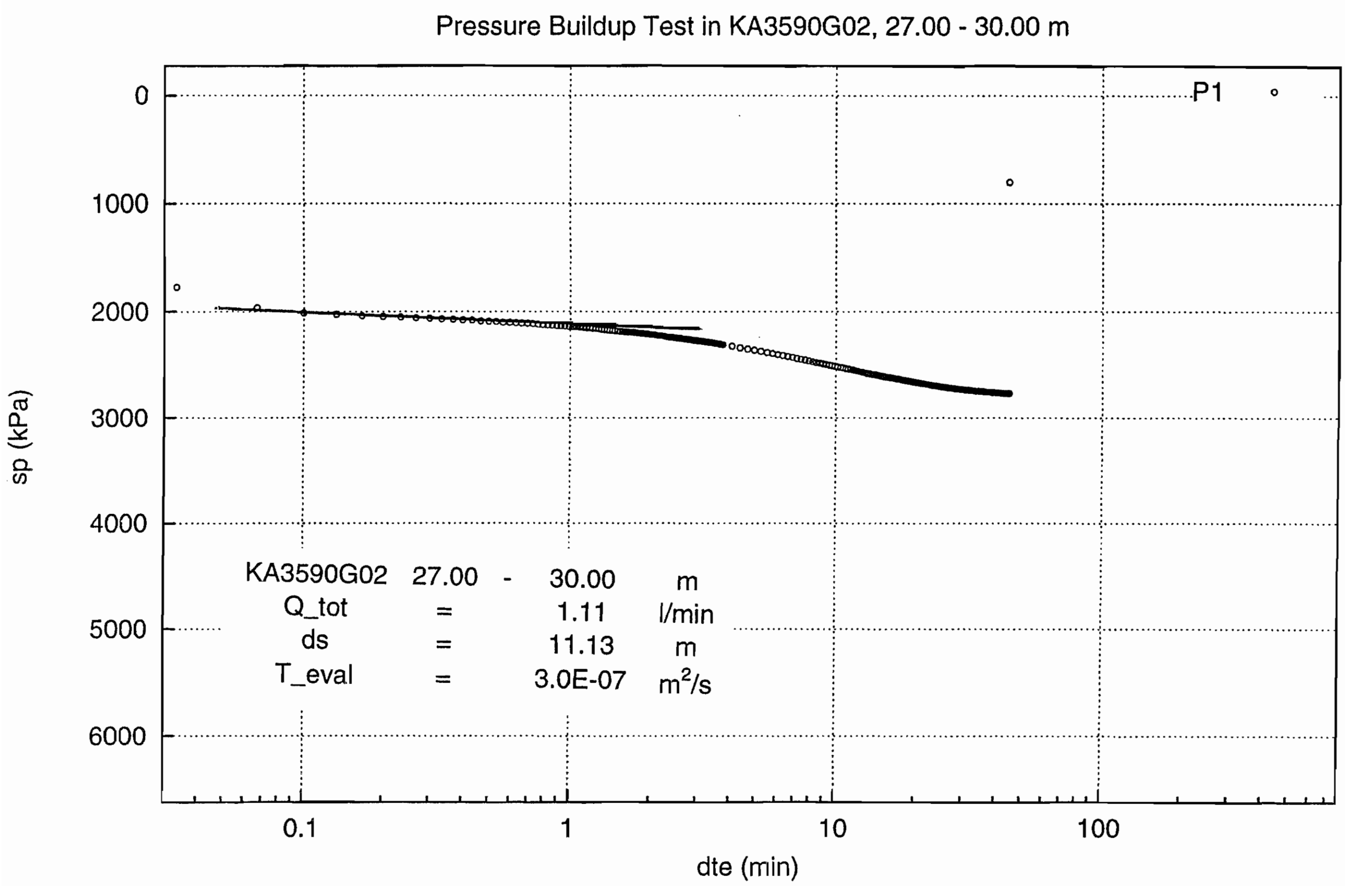


Pressure Buildup Test in KA3590G02, 24.00 - 27.00 m



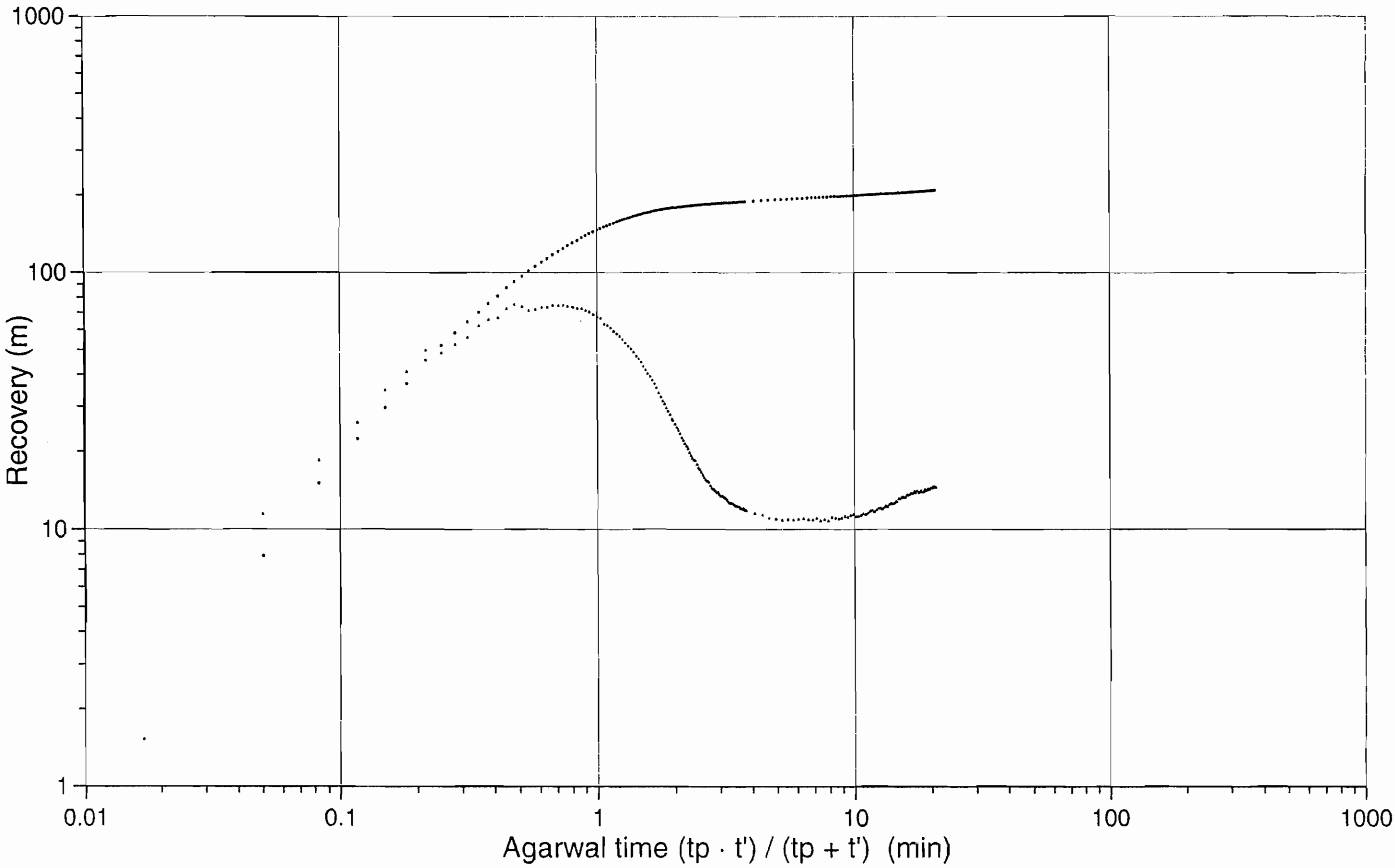


Pressure Buildup Test in KA3590G02, 27.00 - 30.00 m
P1
sp (kPa)
100000
10000
1000
0.01
0.1
1
10
100
dte (min)

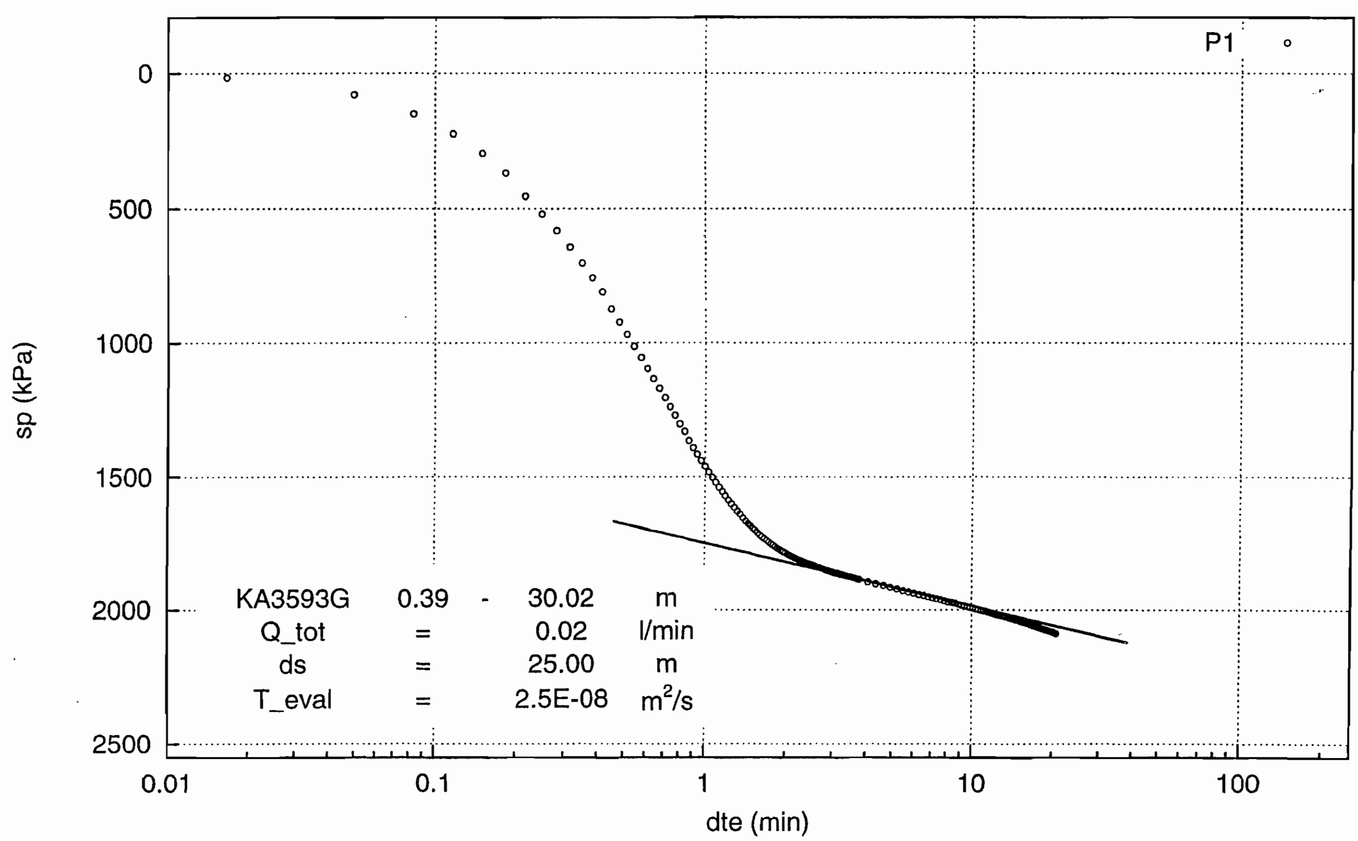


Pressure Buildup Test in KA3590G02, 27.00 - 30.00 m
P1
sp (kPa)
0
1000
2000
3000
4000
5000
6000
0.1
1
10
100
dte (min)
KA3590G02 27.00 - 30.00 m
Q_tot = 1.11 l/min
ds = 11.13 m
T_eval = 3.0E-07 m2/s

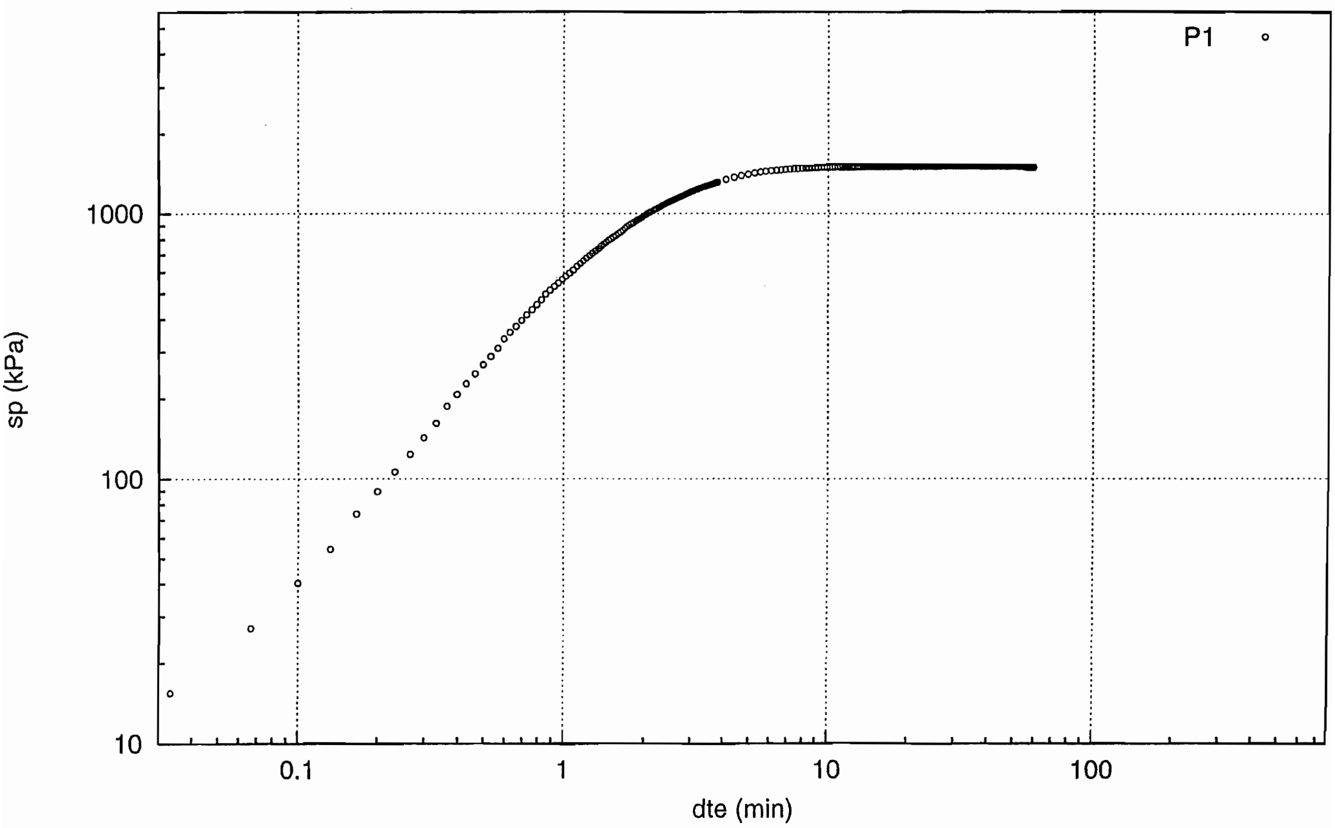
KA3593G, 0.39 - 30.02 m



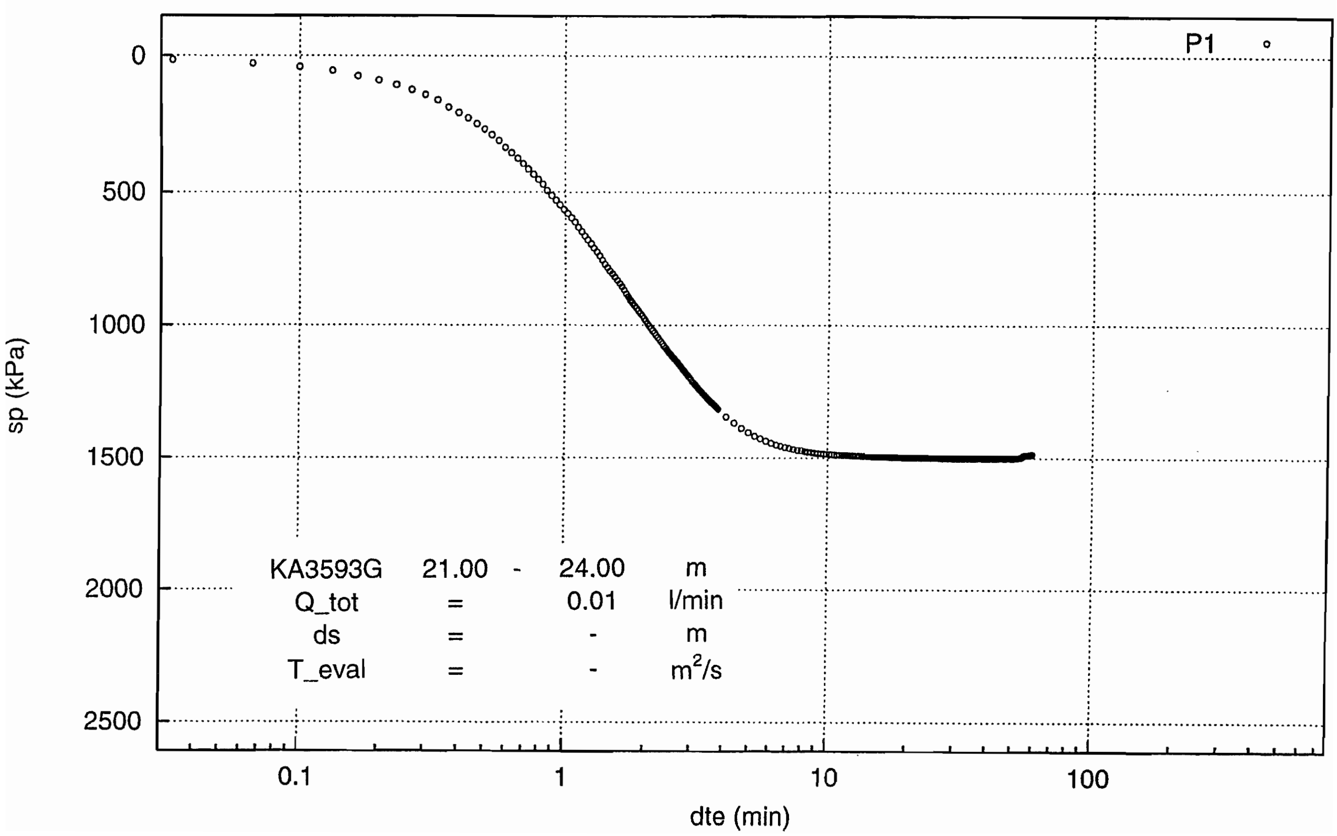
Interference test(recovery)in KA3593G

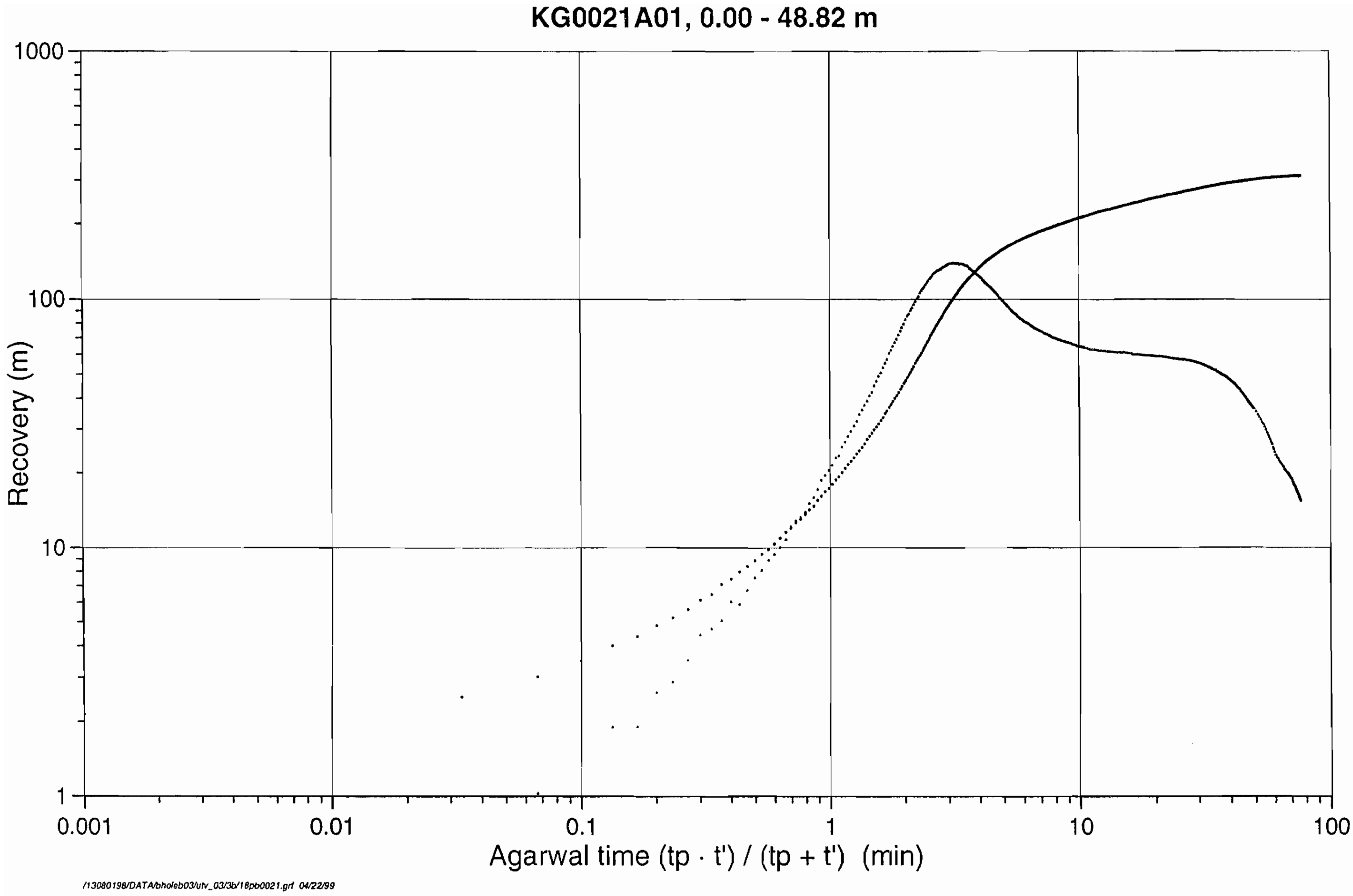


Pressure Buildup Test in KA3593G, 21.00 - 24.00 m

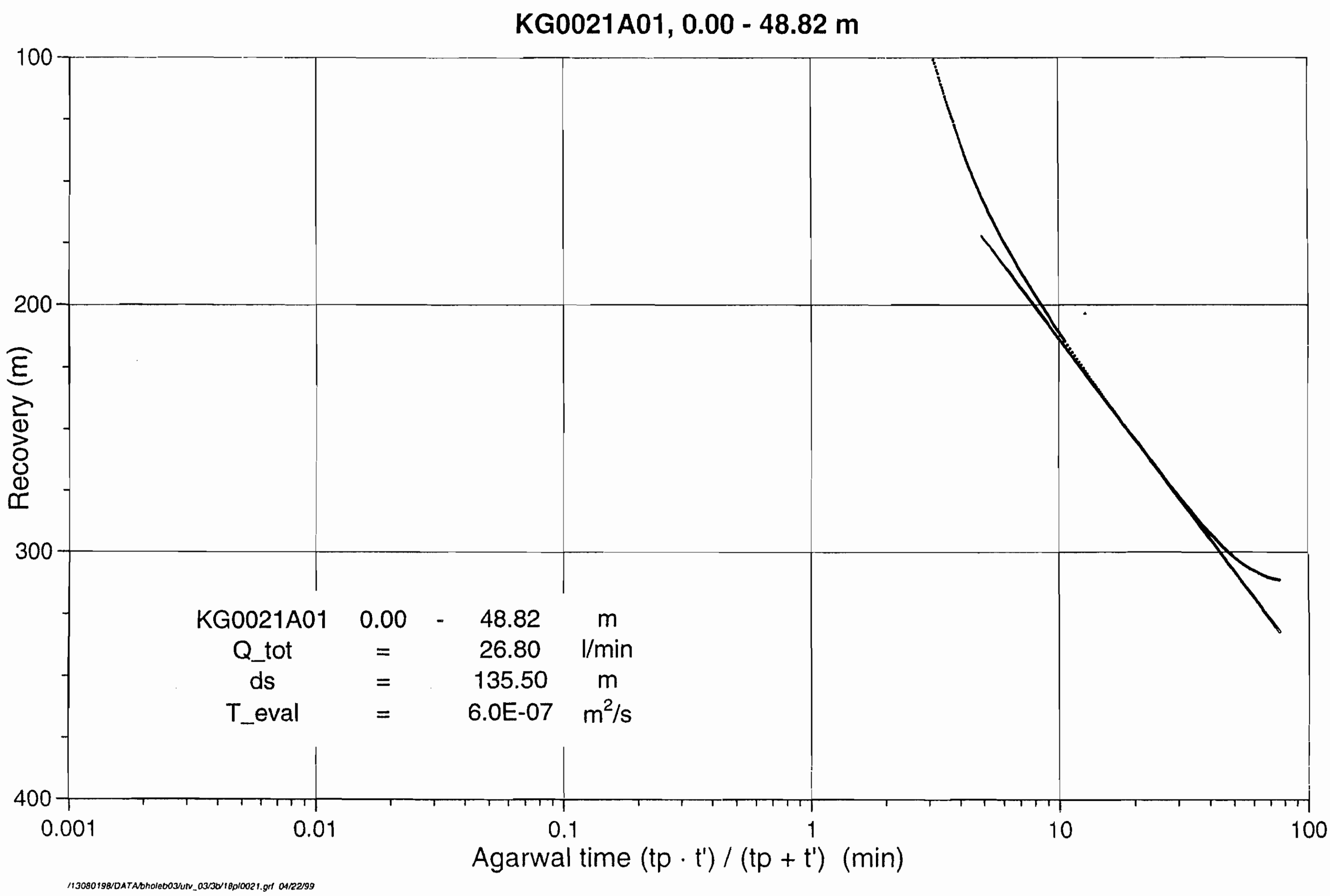


Pressure Buildup Test in KA3593G, 21.00 - 24.00 m



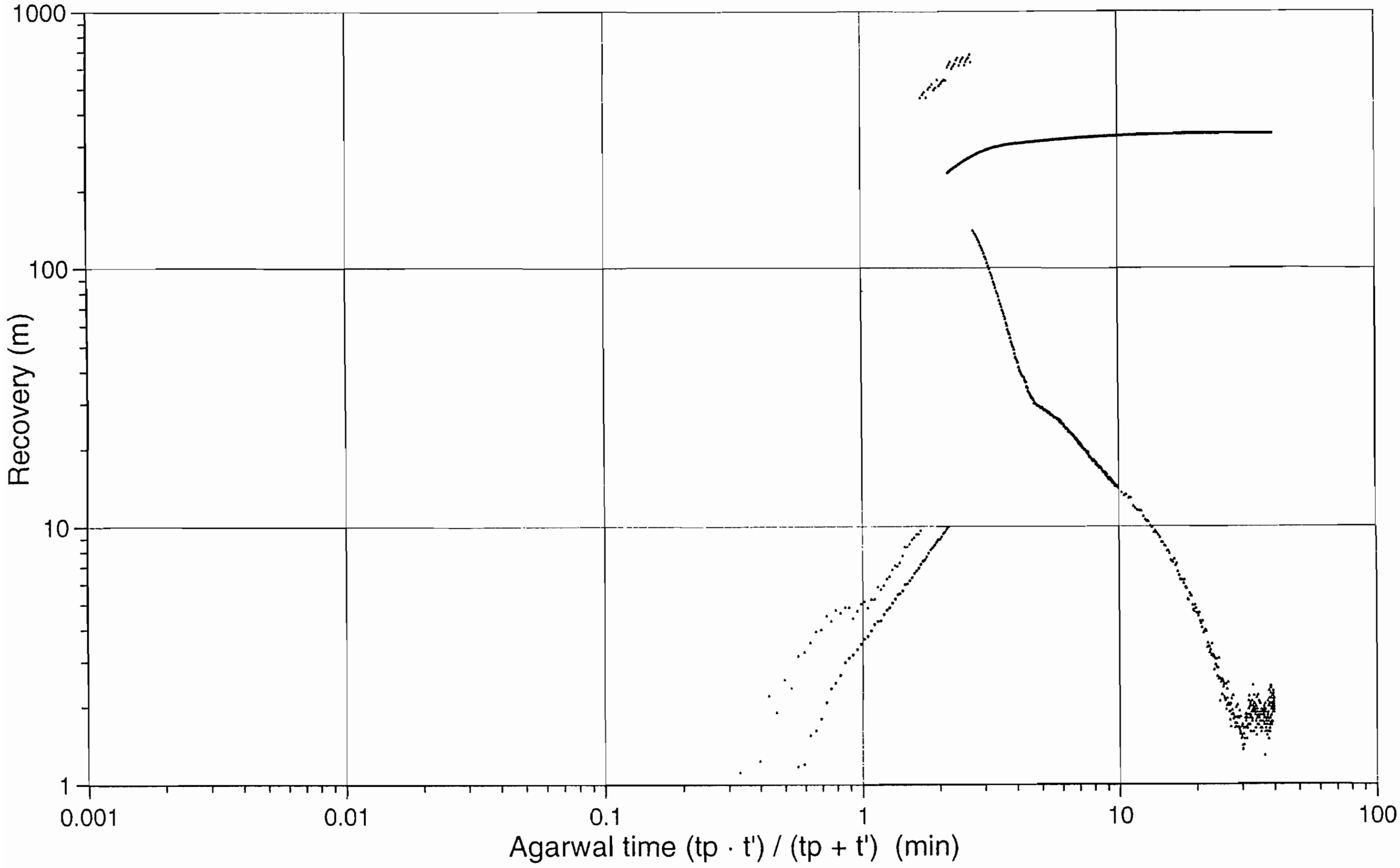


KG0021A01, 0.00 - 48.82 m
1000
100
10
1
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/18pb0021.grf 04/22/99



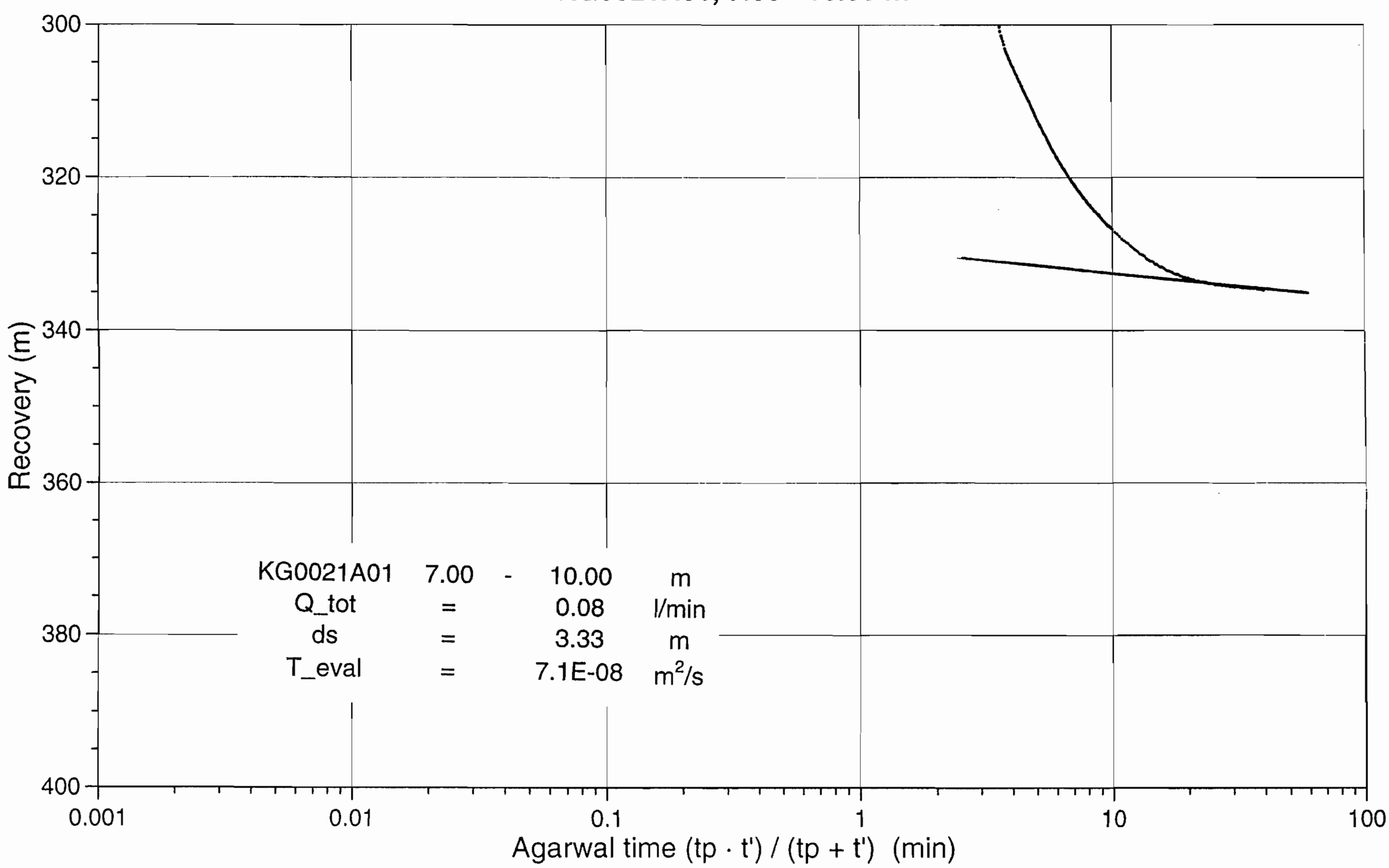
KG0021A01, 0.00 - 48.82 m
100
200
300
400
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
KG0021A01 0.00 - 48.82 m
Q_tot = 26.80 l/min
ds = 135.50 m
T_eval = 6.0E-07 m²/s
/13080198/DATA/bholeb03/utv_03/3b/18pl0021.grf 04/22/99

KG0021A01, 7.00 - 10.00 m

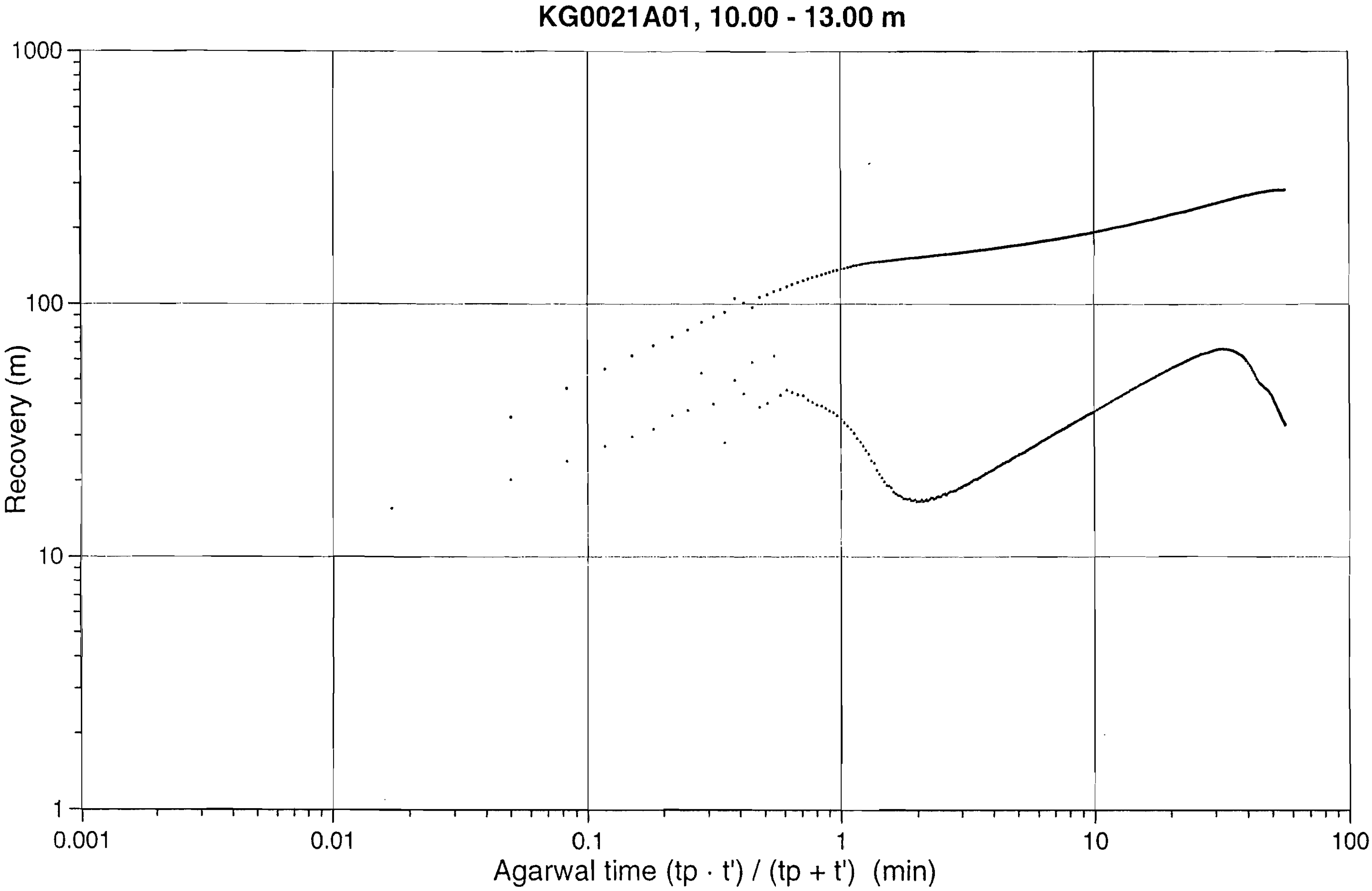


/13080198/DATA/bholeb03/utv_03/3b/19pb0021.grf 04/22/99

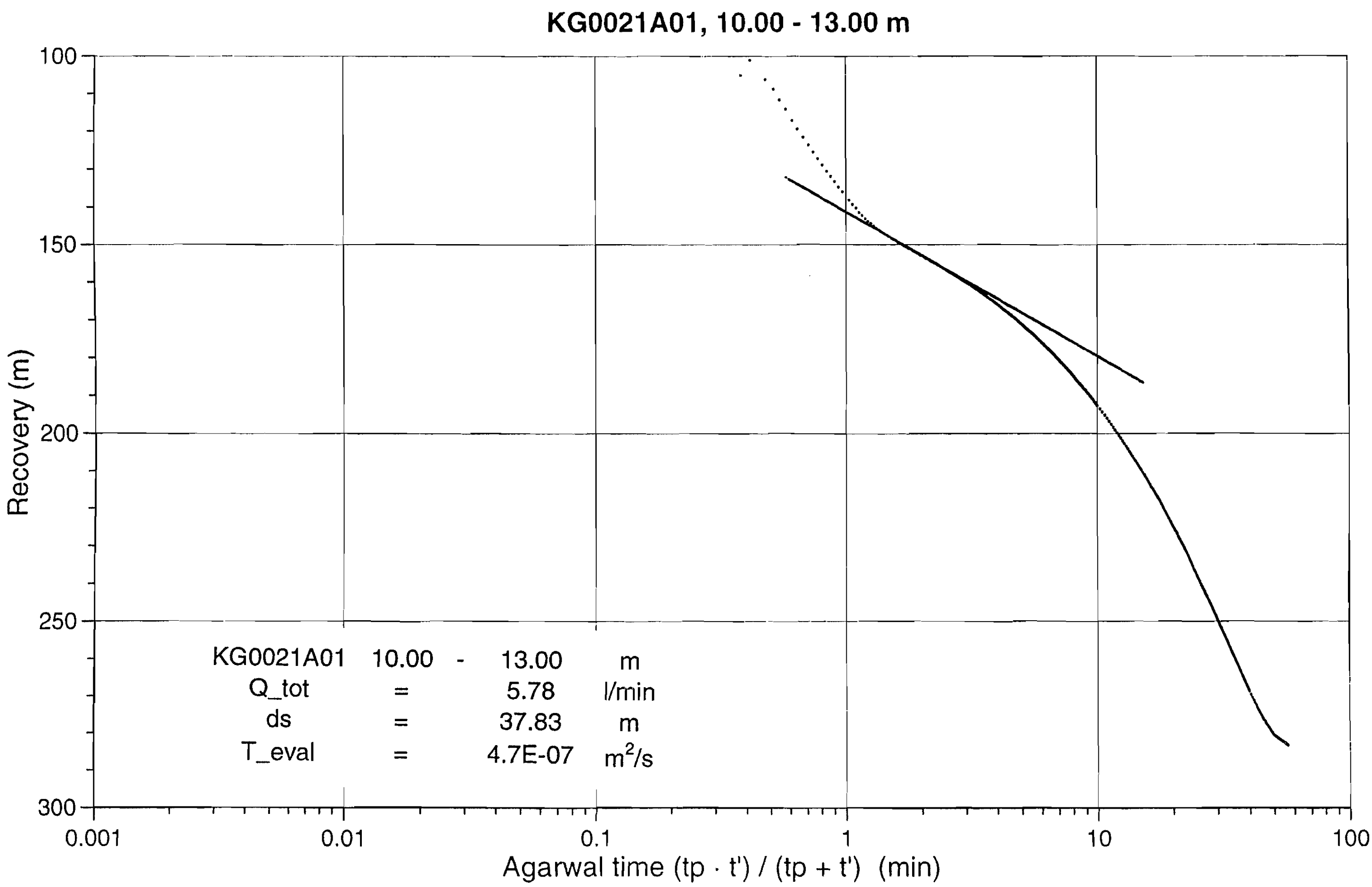
KG0021A01, 7.00 - 10.00 m



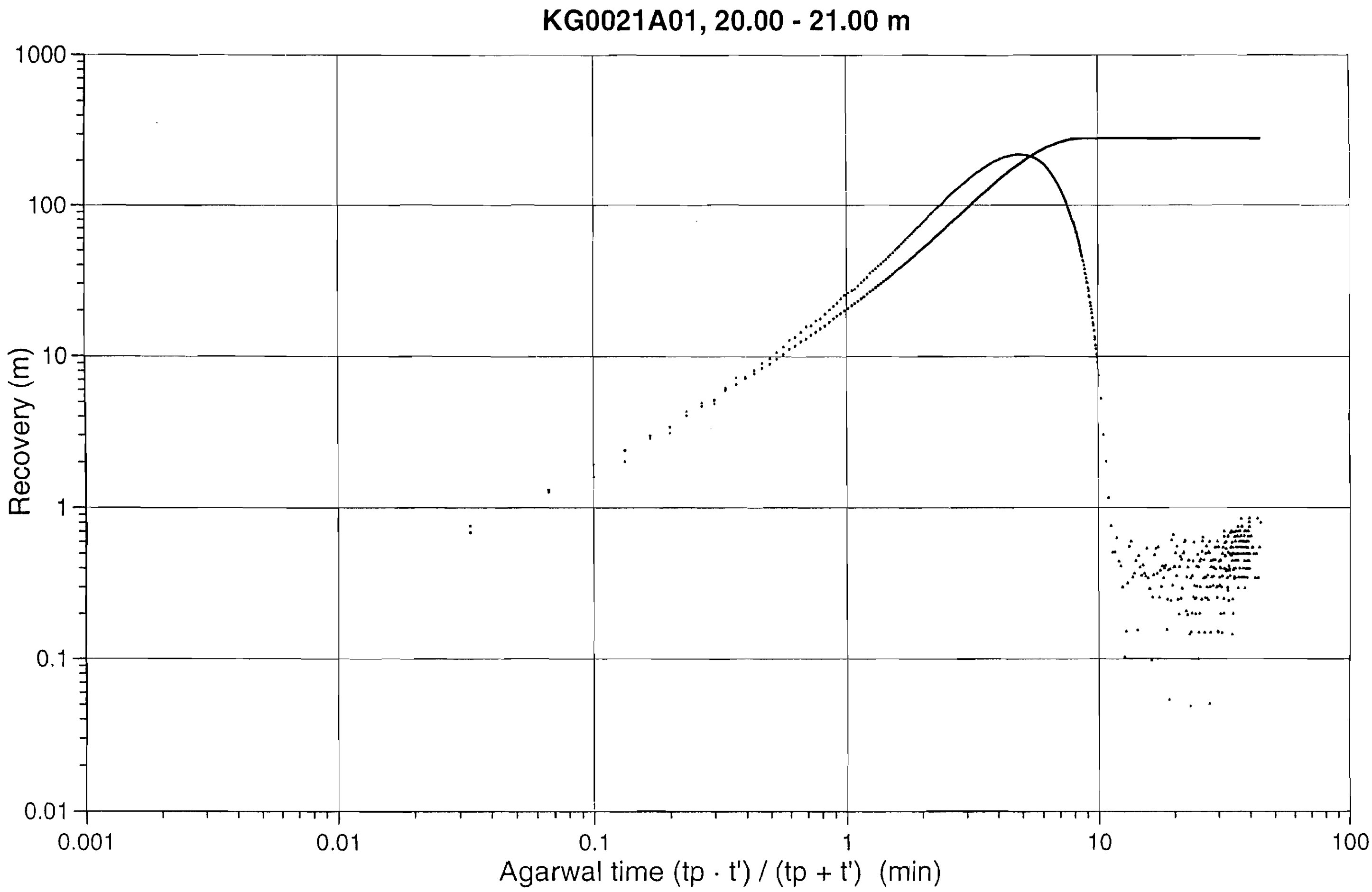
/13080198/DATA/bholeb03/utv_03/3b/19pl0021.grf 04/22/99



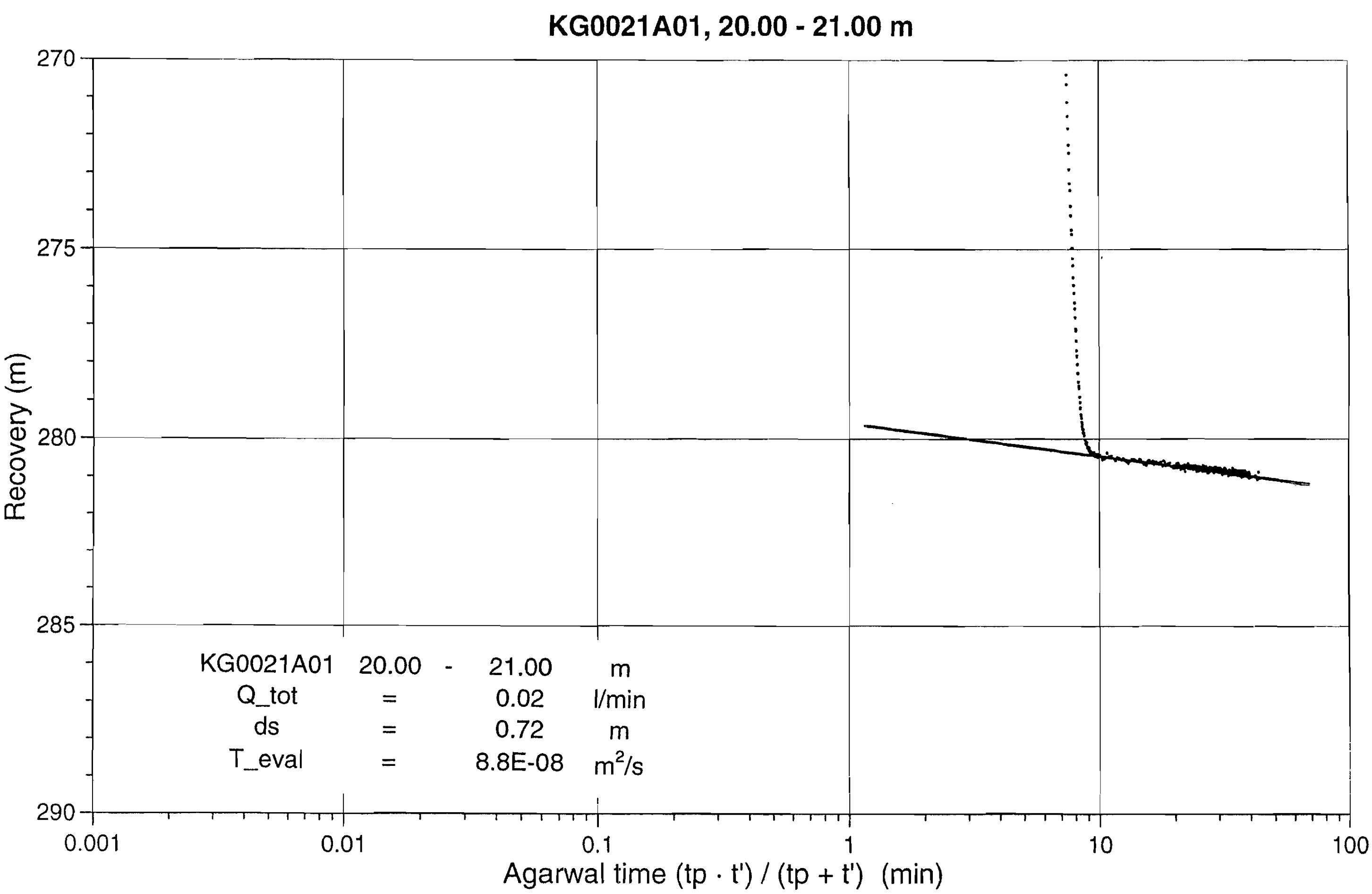
/13080198/DATA/bholeb03/utv_03/3b/20pb0021.grf 04/22/99



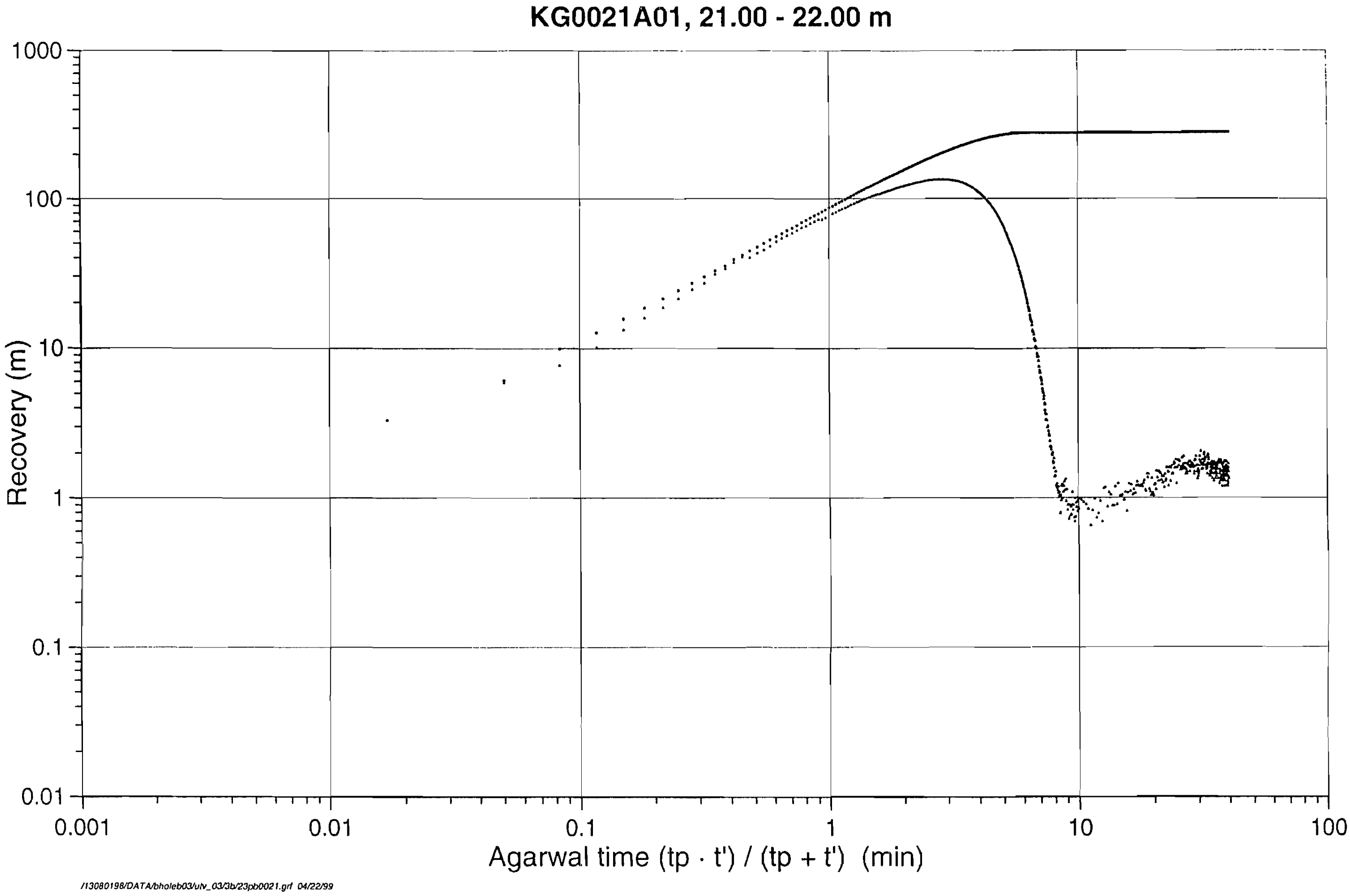
/13080198/DATA/bholeb03/utv_03/3b/20pl0021.grf 04/22/99

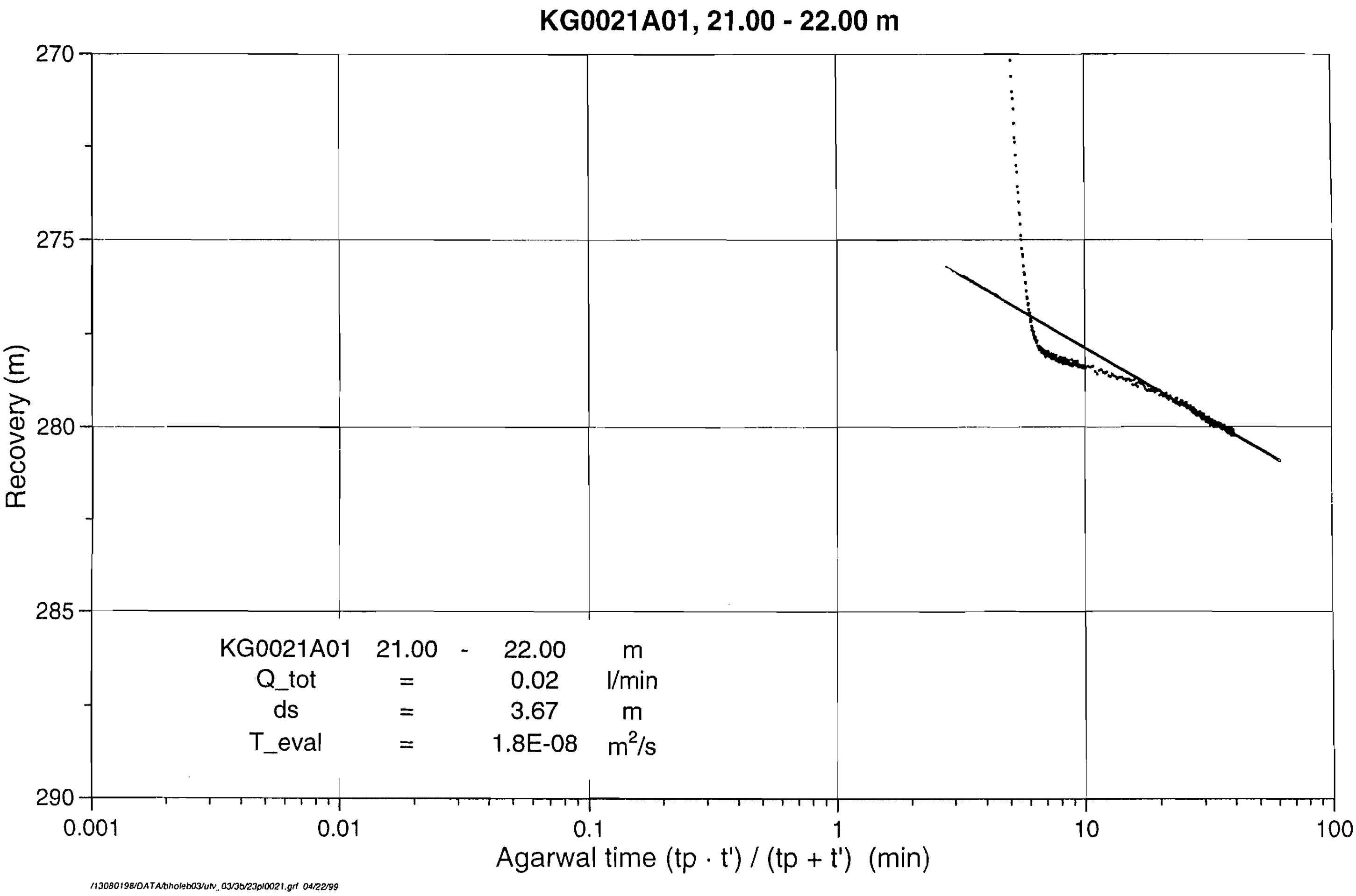


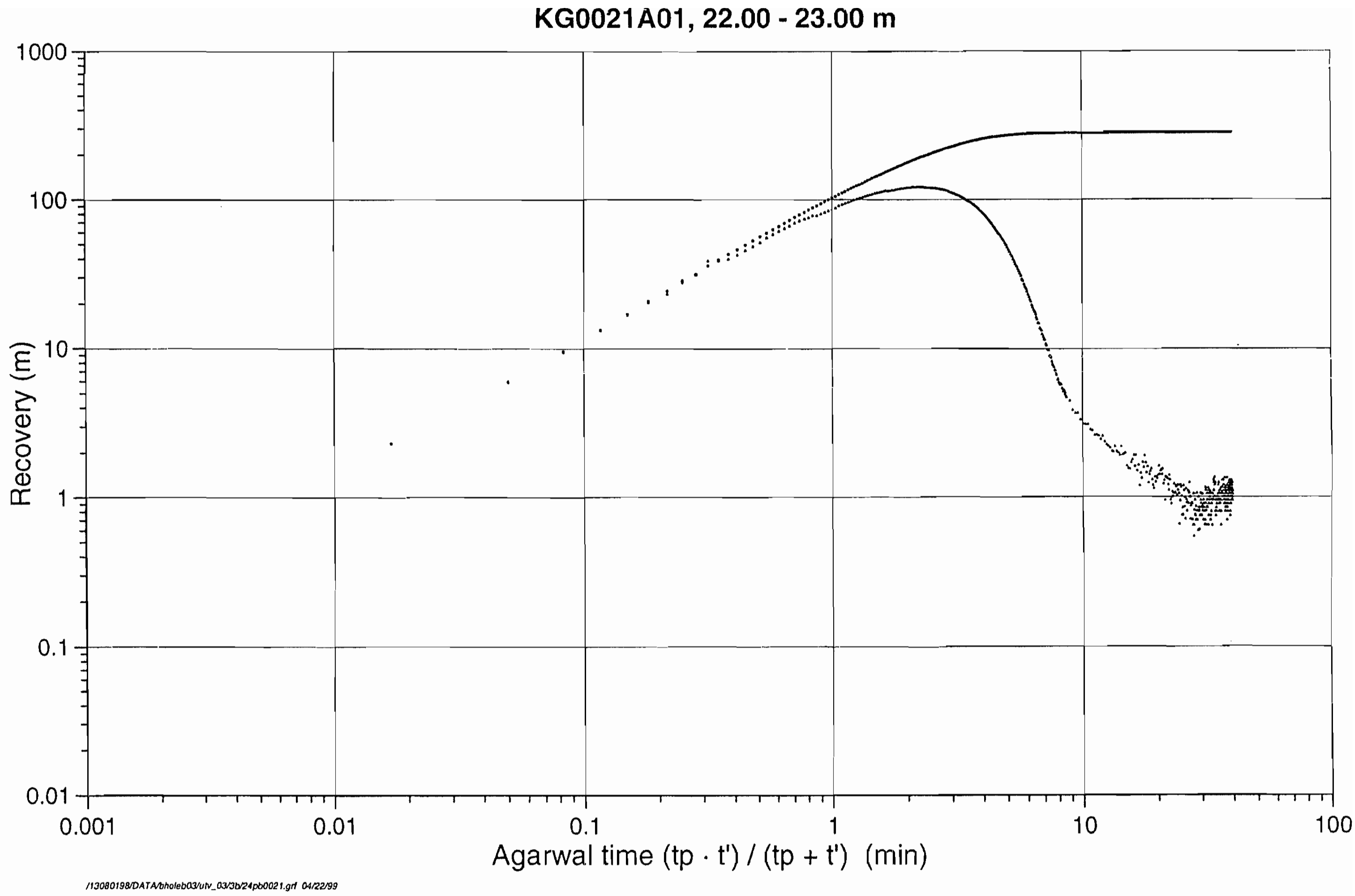
/13080198/DATA/bholeb03/utv_03/3b/22pb0021.grf 04/22/99

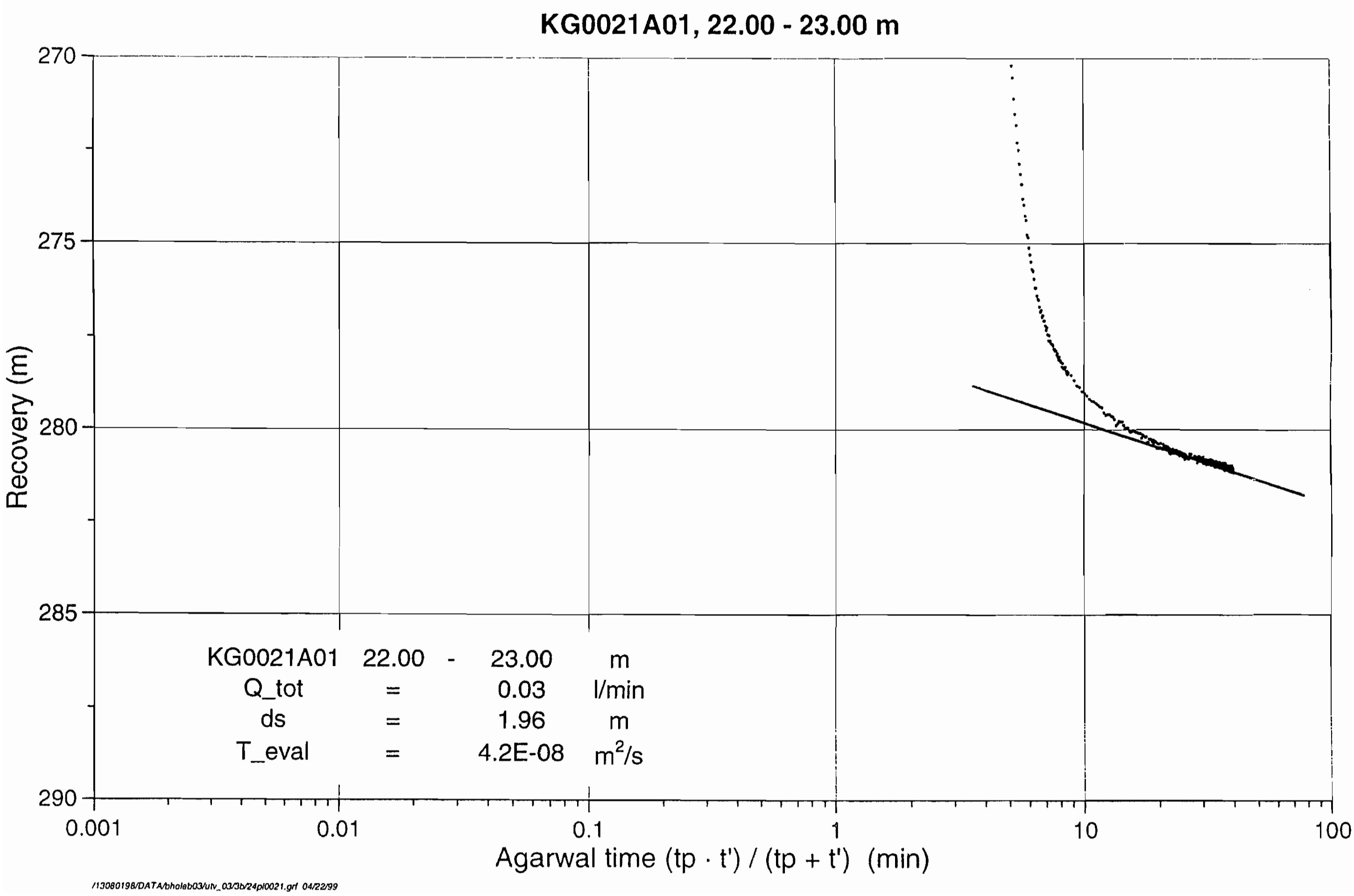


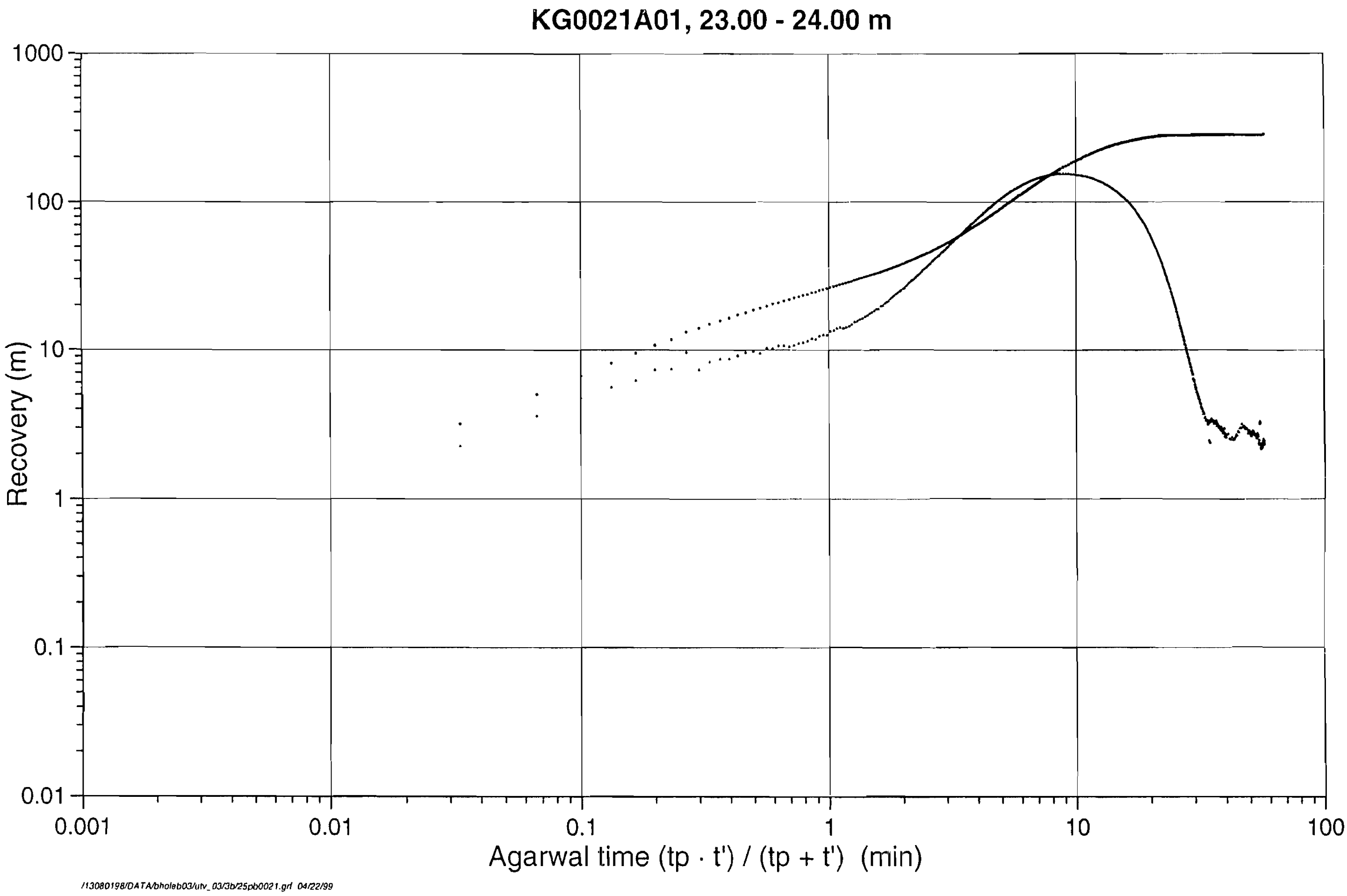
/13080198/DATA/bholeb03/utv_03/3b/22pl0021.grf 04/22/99


KG0021A01, 21.00 - 22.00 m
1000
100
10
1
0.1
0.01
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/ulv_03/3b/23pb0021.grf 04/22/99

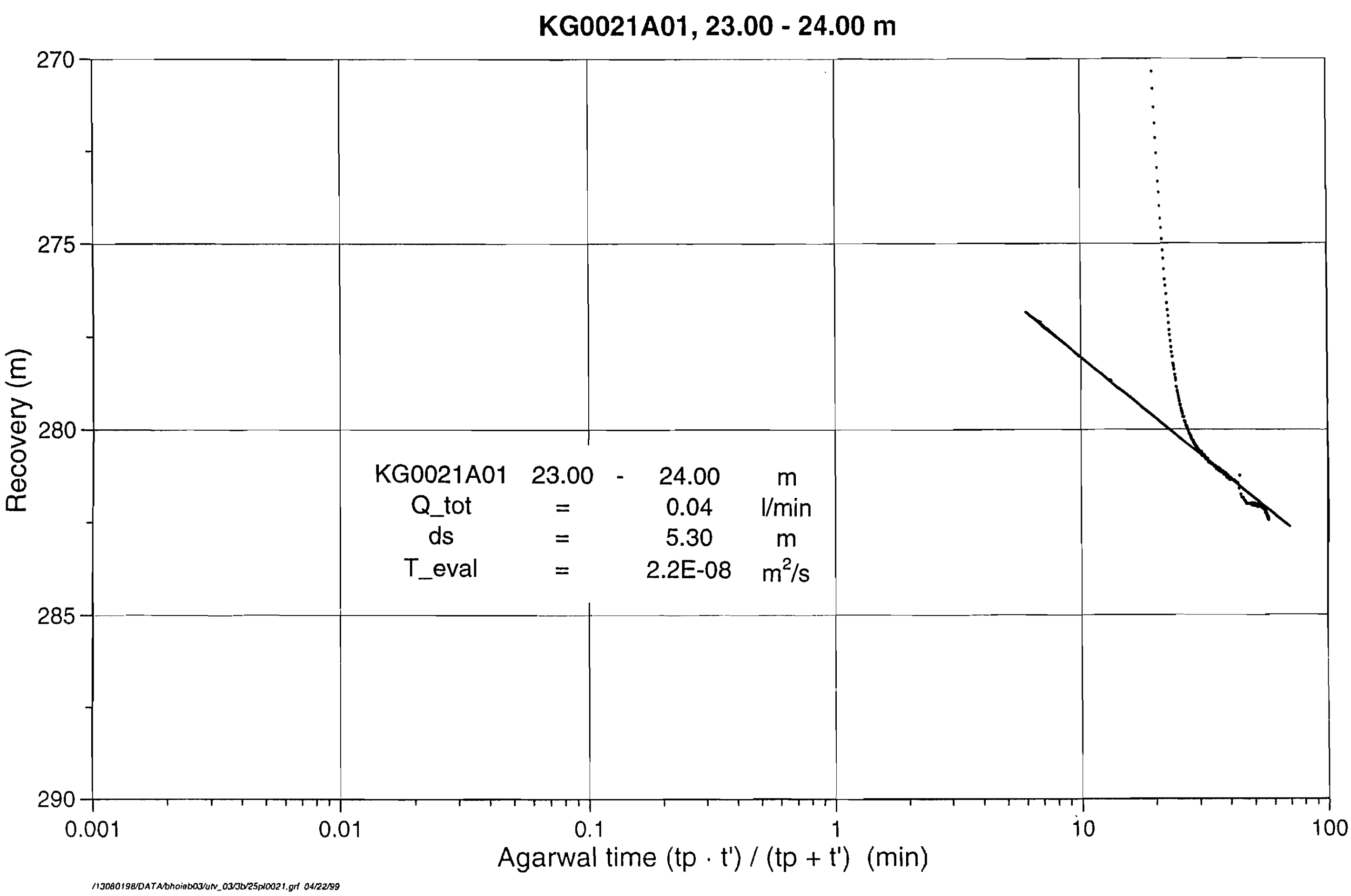

KG0021A01, 21.00 - 22.00 m
270
275
280
285
290
Recovery (m)
KG0021A01 21.00 - 22.00 m
Q_tot = 0.02 l/min
ds = 3.67 m
T_eval = 1.8E-08 m2/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/ulv_03/3b/23pl0021.grf 04/22/99


KG0021A01, 22.00 - 23.00 m
1000
100
10
1
0.1
0.01
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/24pb0021.grf 04/22/99

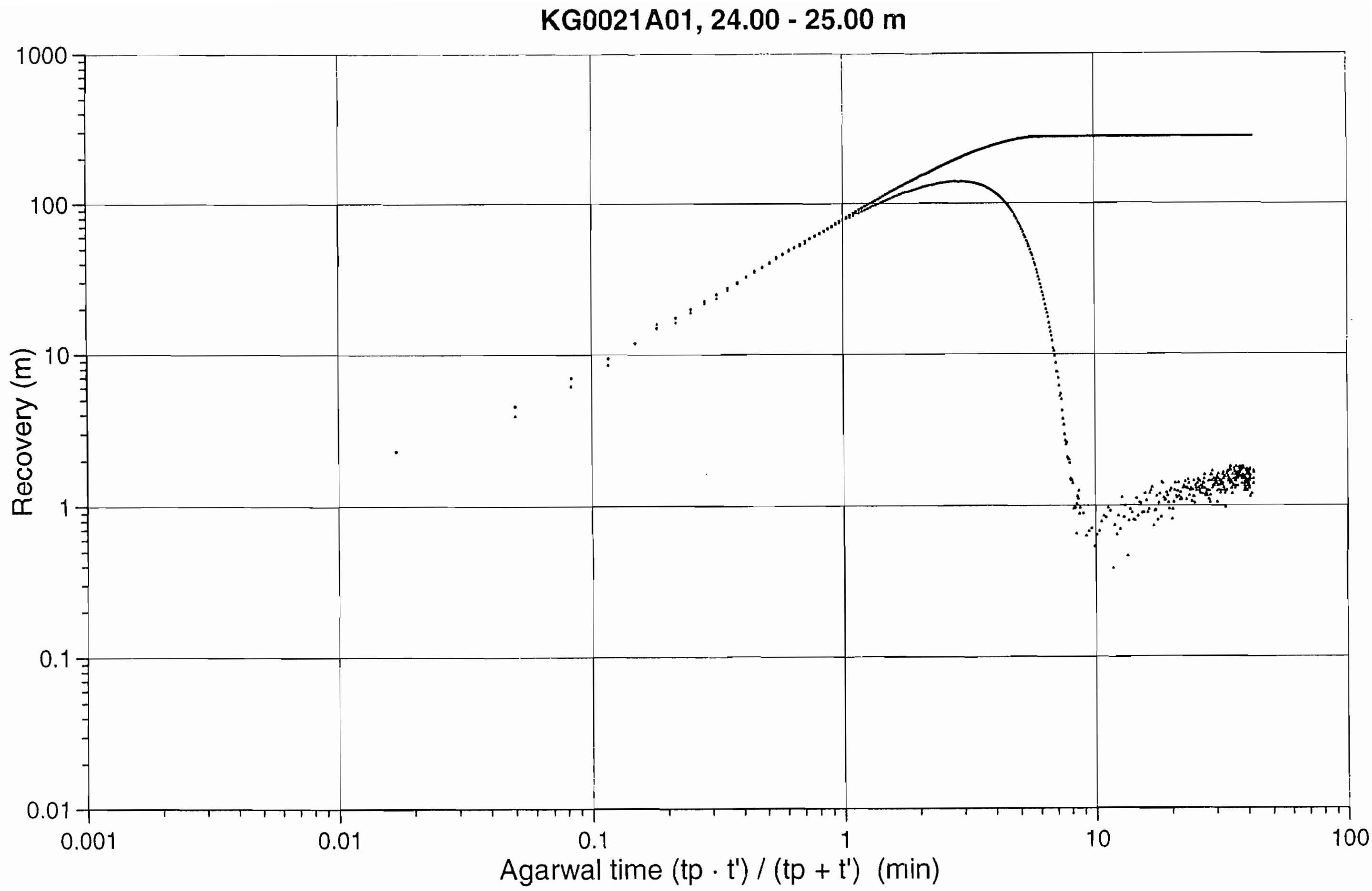

KG0021A01, 22.00 - 23.00 m
270
275
280
285
290
Recovery (m)
KG0021A01 22.00 - 23.00 m
Q_tot = 0.03 l/min
ds = 1.96 m
T_eval = 4.2E-08 m2/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/24pl0021.grf 04/22/99



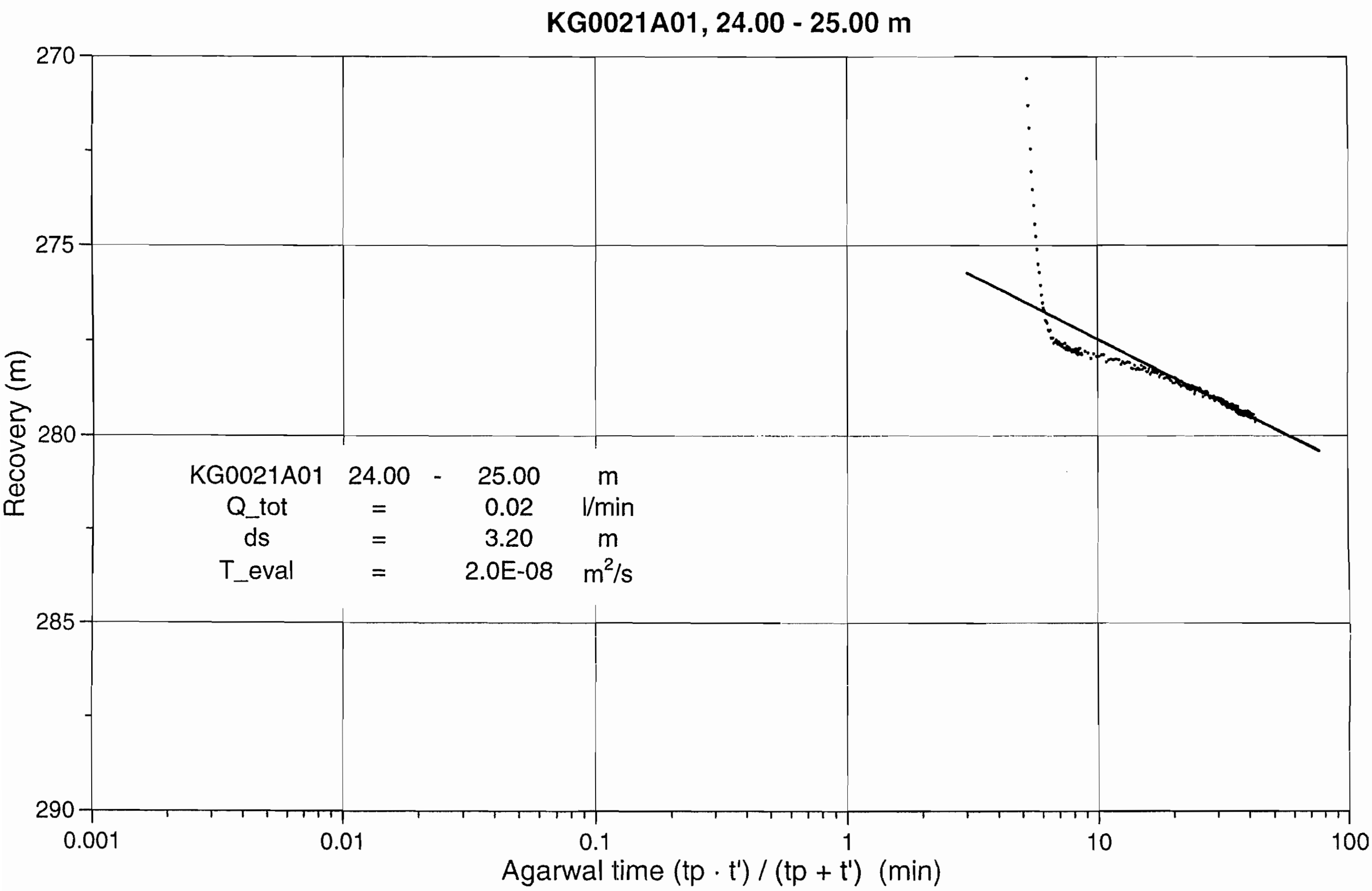
KG0021A01, 23.00 - 24.00 m
Recovery (m)
1000
100
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/25pb0021.grf 04/22/99



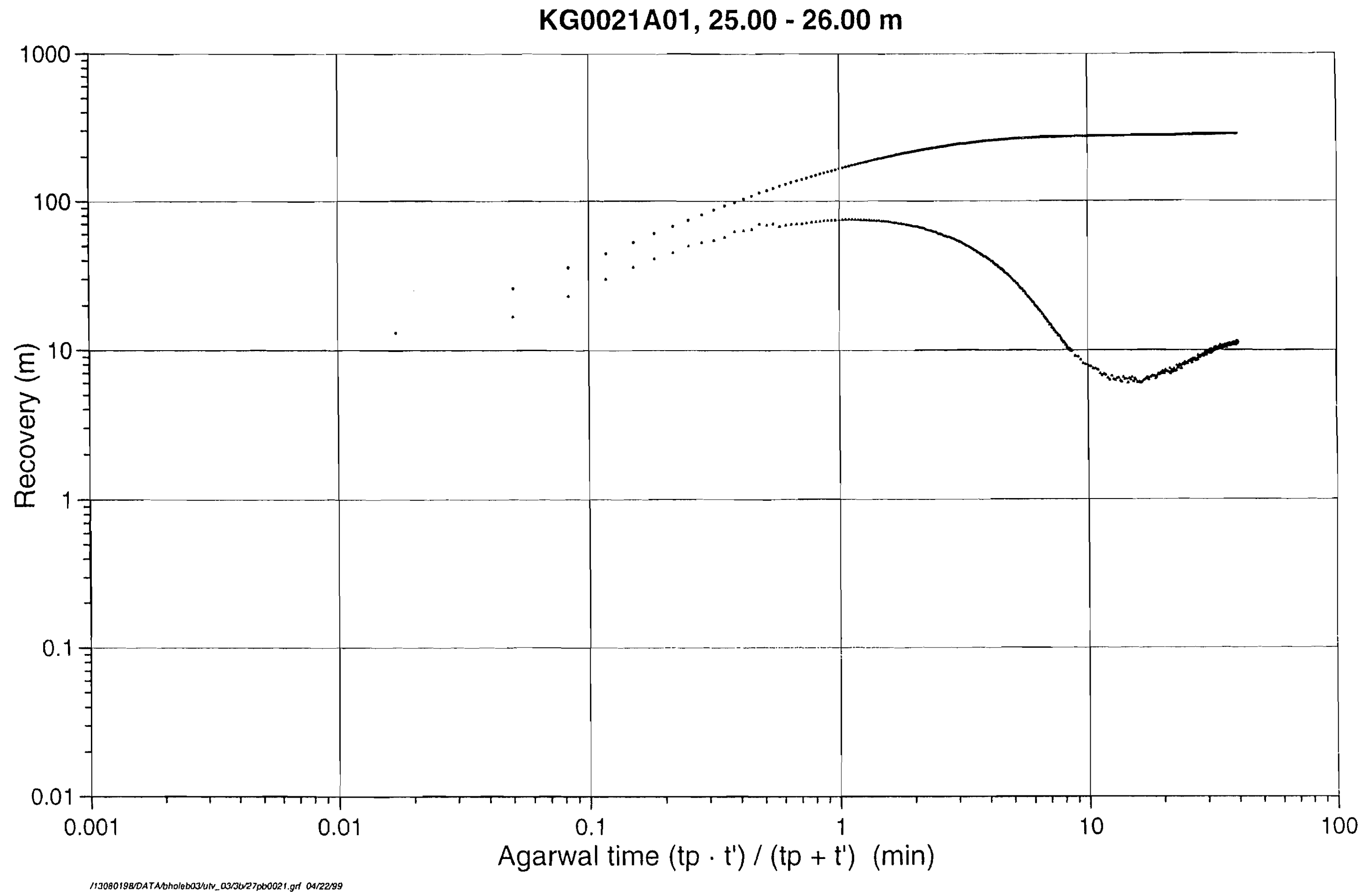
KG0021A01, 23.00 - 24.00 m
Recovery (m)
270
275
280
285
290
KG0021A01 23.00 - 24.00 m
Q_tot = 0.04 l/min
ds = 5.30 m
T_eval = 2.2E-08 m²/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/25pl0021.grf 04/22/99

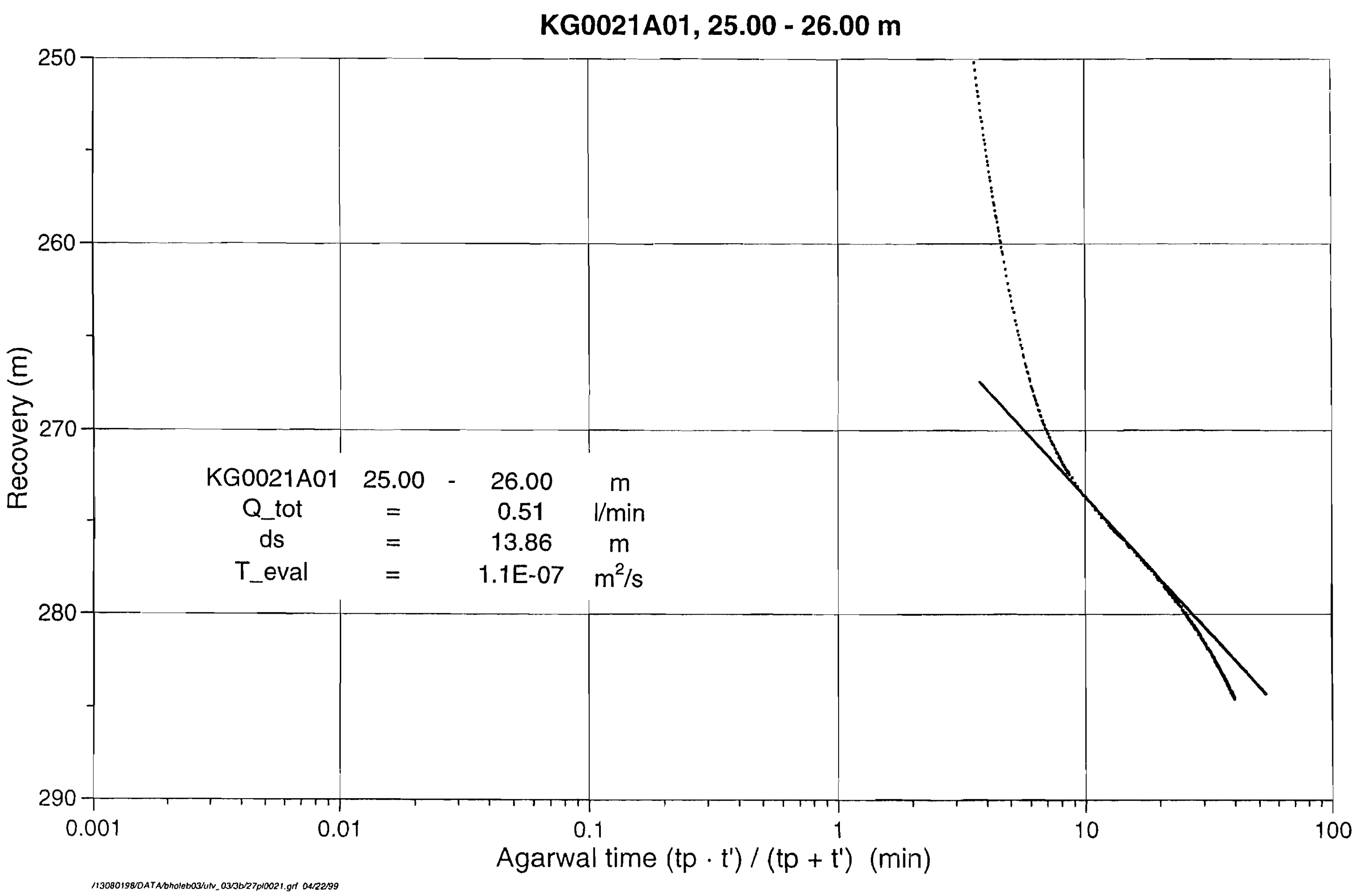


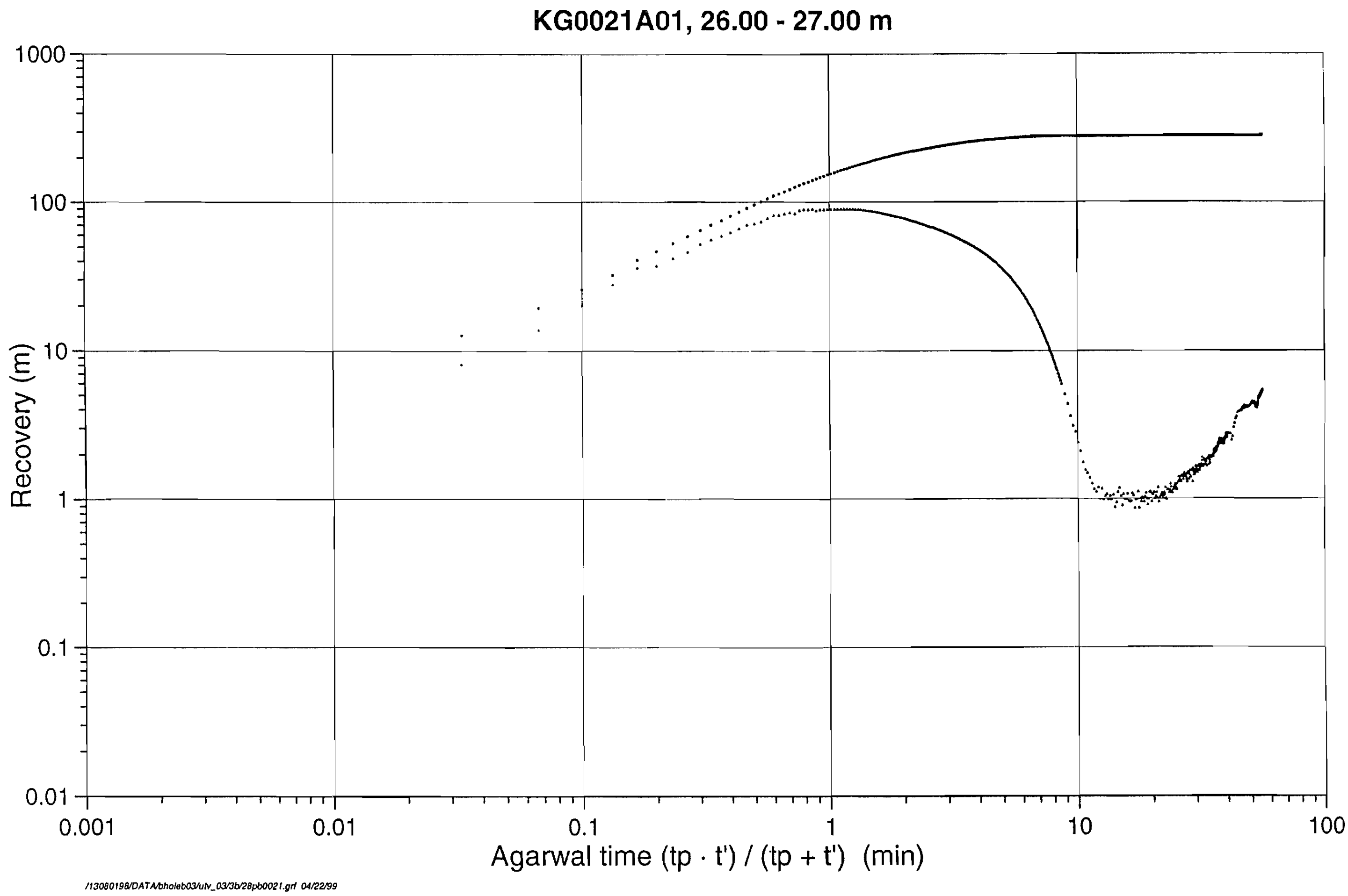
/13080198/DATA/bholeb03/utv_03/3b/26pb0021.grf 04/22/99

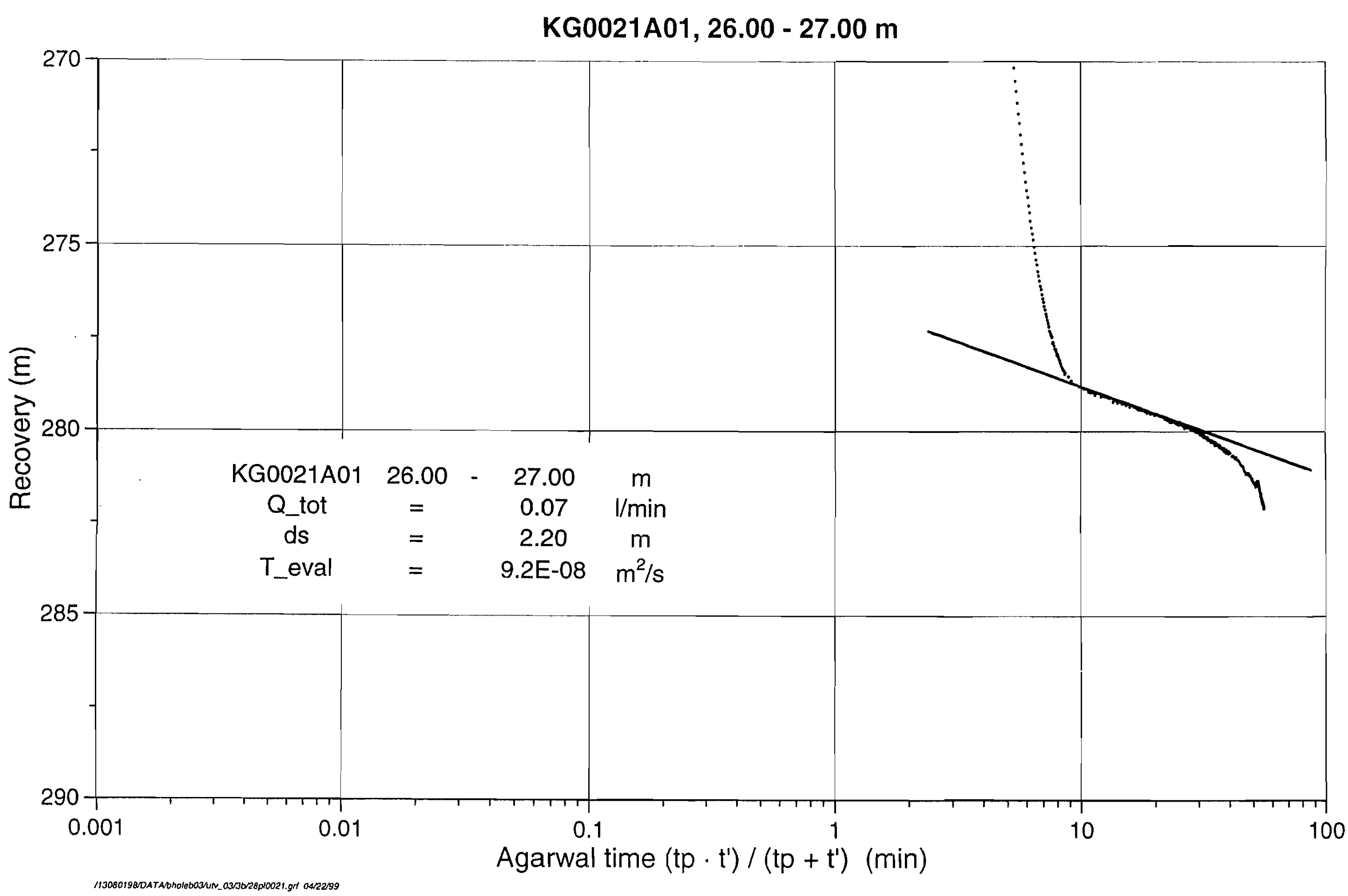


/13080198/DATA/bholeb03/utv_03/3b/26pl0021.grf 04/22/99

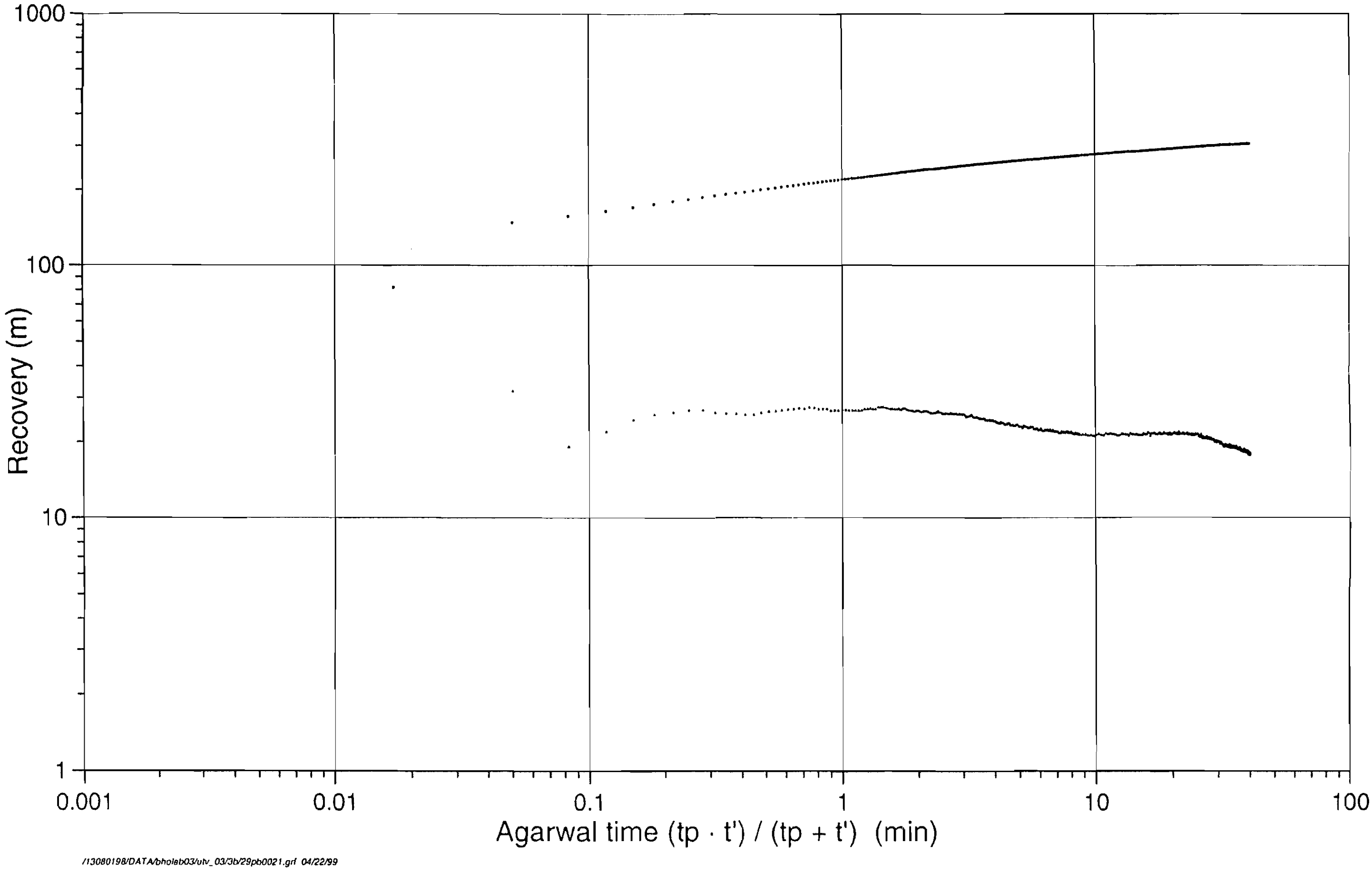

KG0021A01, 25.00 - 26.00 m
Recovery (m)
1000
100
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/27pb0021.grf 04/22/99


KG0021A01, 25.00 - 26.00 m
Recovery (m)
250
260
270
280
290
KG0021A01 25.00 - 26.00 m
Q_tot = 0.51 l/min
ds = 13.86 m
T_eval = 1.1E-07 m²/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/27pl0021.grf 04/22/99

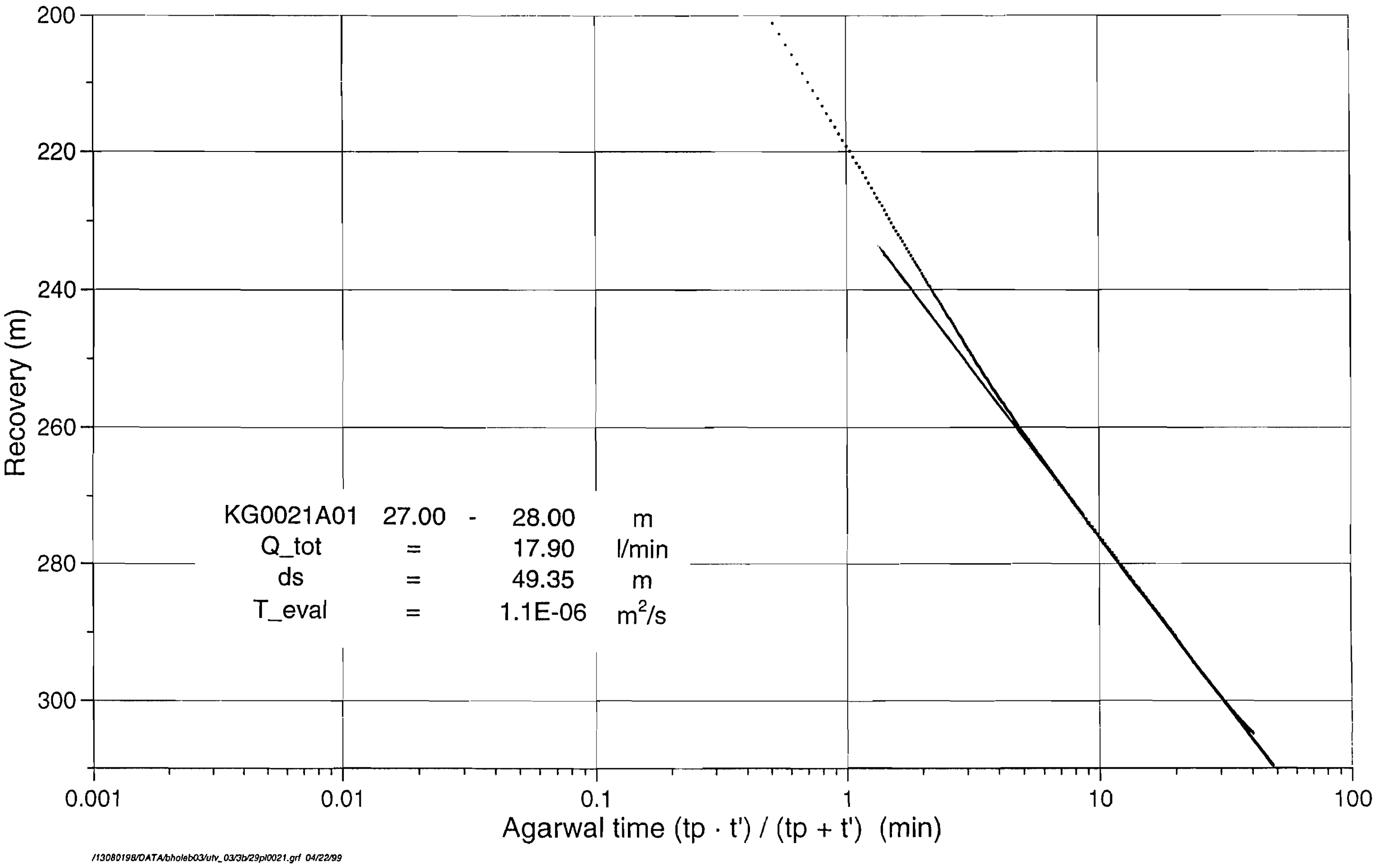

KG0021A01, 26.00 - 27.00 m
Recovery (m)
1000
100
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/28pb0021.grf 04/22/99


KG0021A01, 26.00 - 27.00 m
Recovery (m)
270
275
280
285
290
KG0021A01 26.00 - 27.00 m
Q_tot = 0.07 l/min
ds = 2.20 m
T_eval = 9.2E-08 m²/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/28pl0021.grf 04/22/99

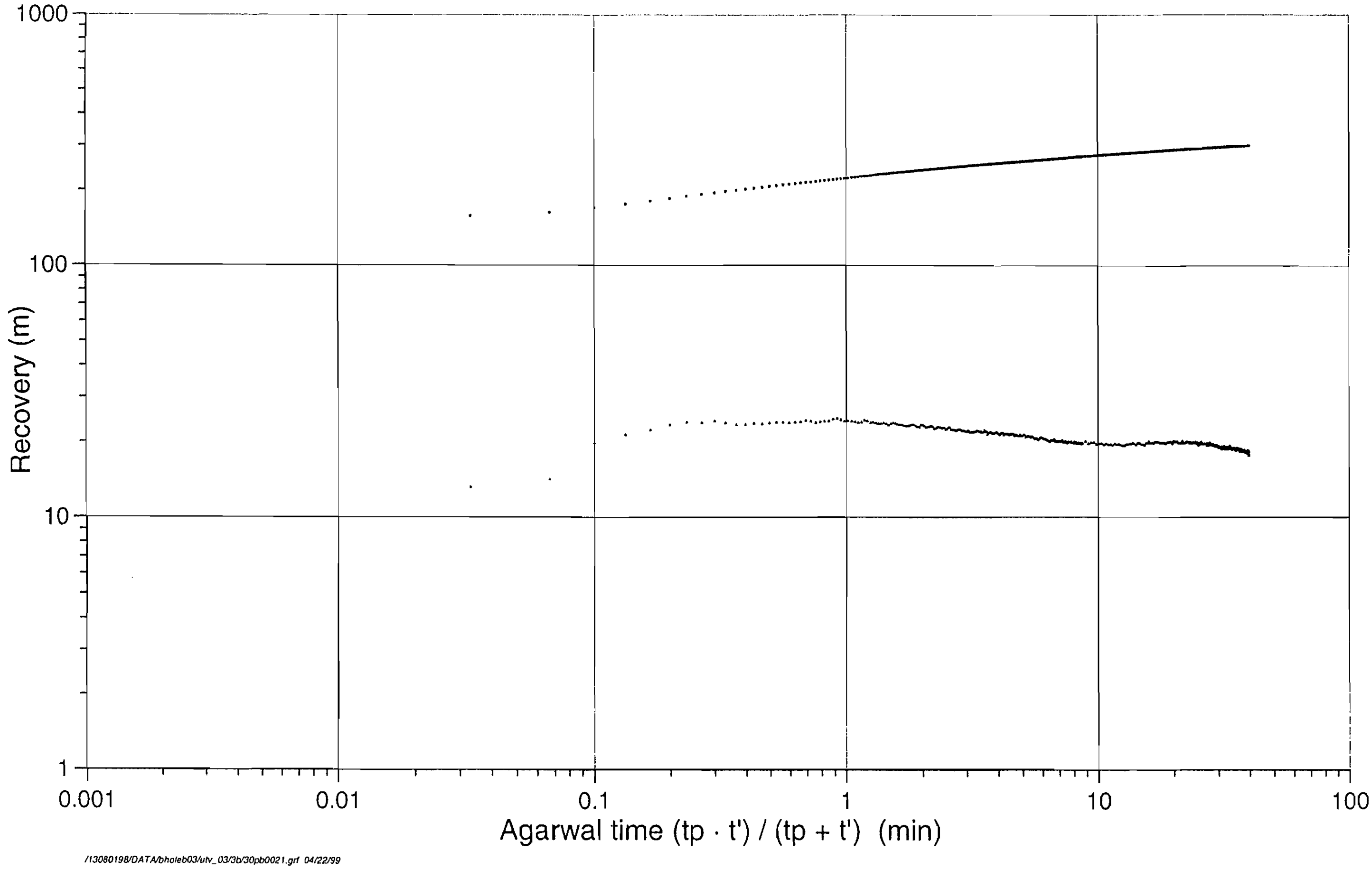
KG0021A01, 27.00 - 28.00 m



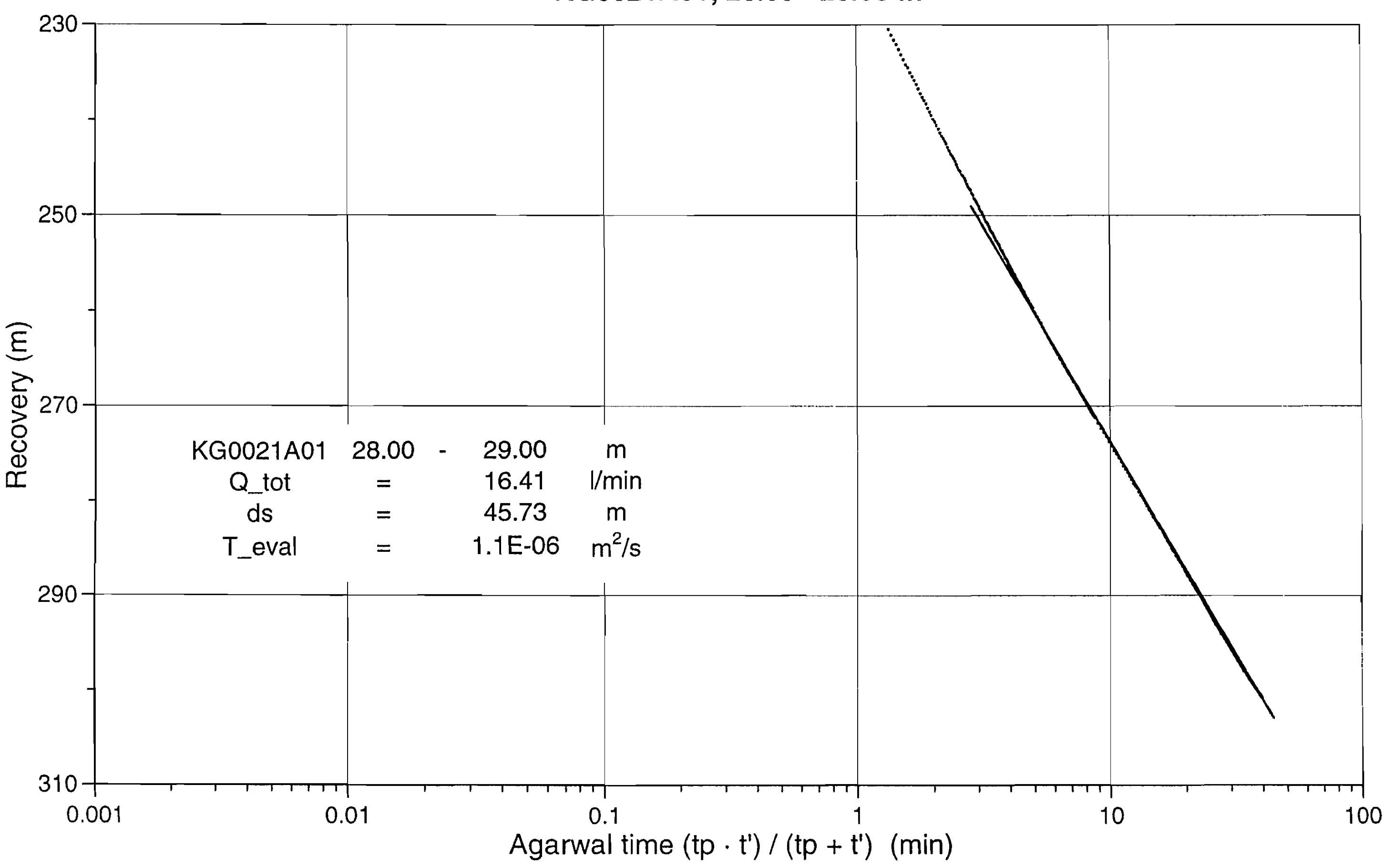
KG0021A01, 27.00 - 28.00 m



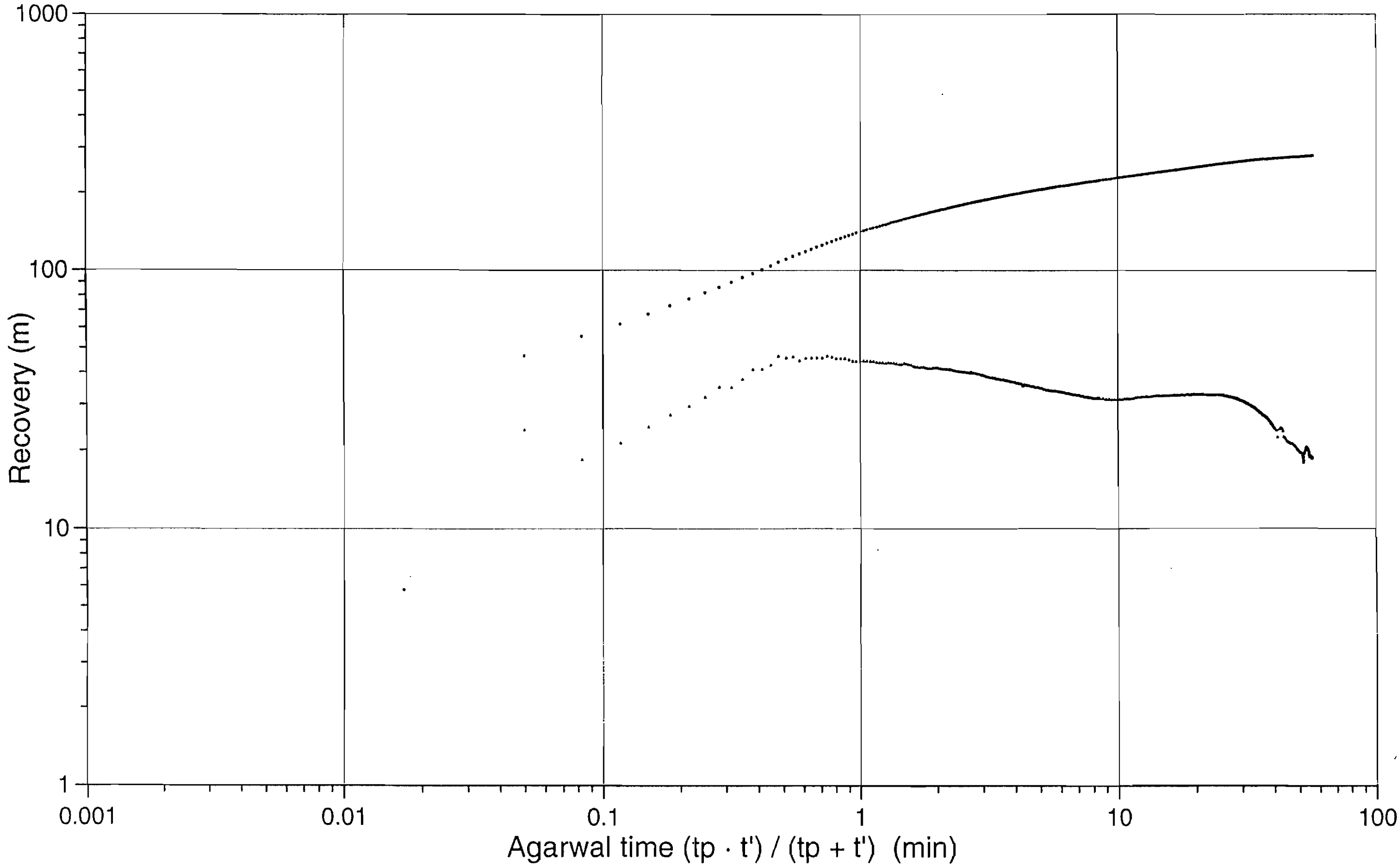
KG0021A01, 28.00 - 29.00 m



KG0021A01, 28.00 - 29.00 m

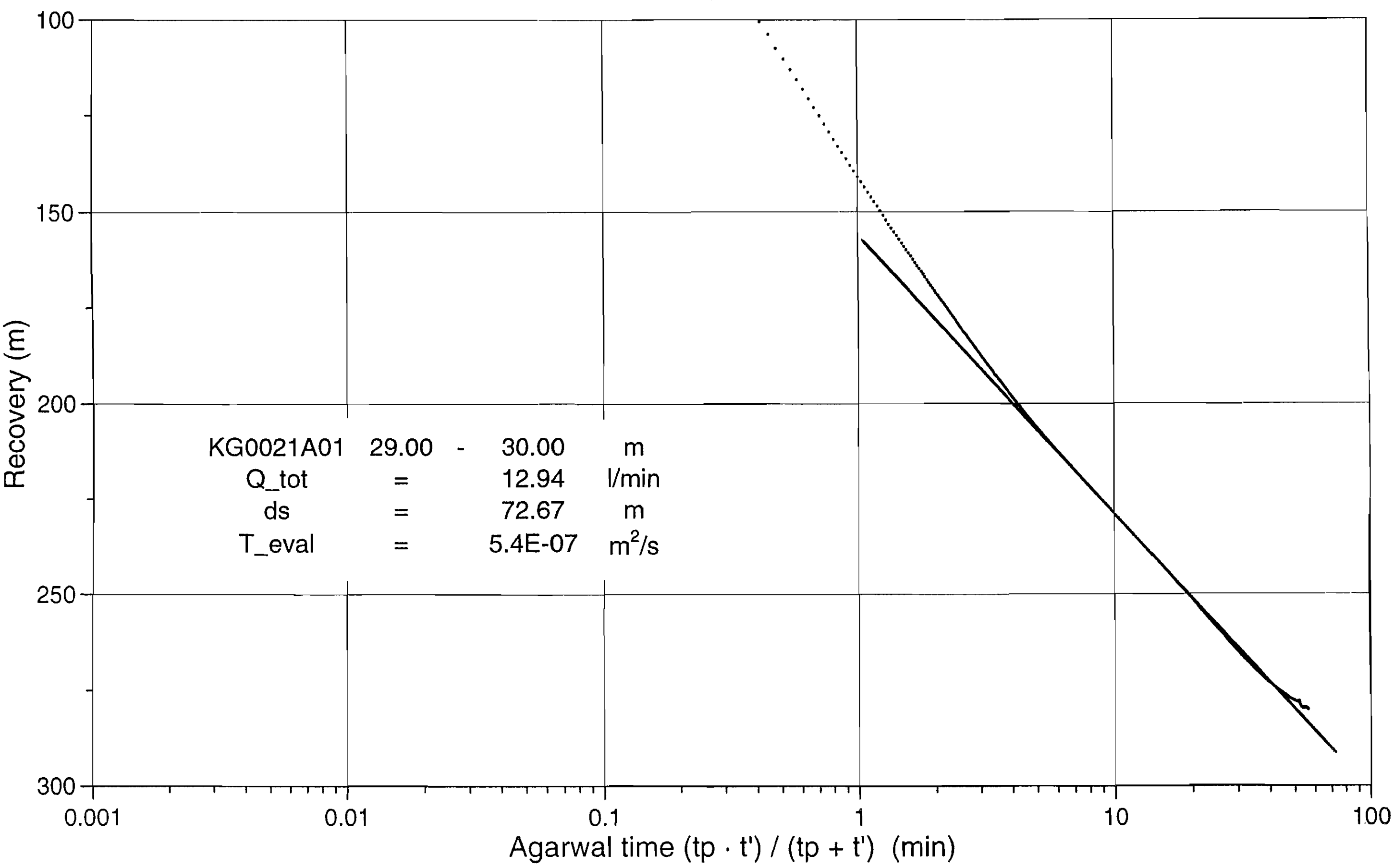


KG0021A01, 29.00 - 30.00 m

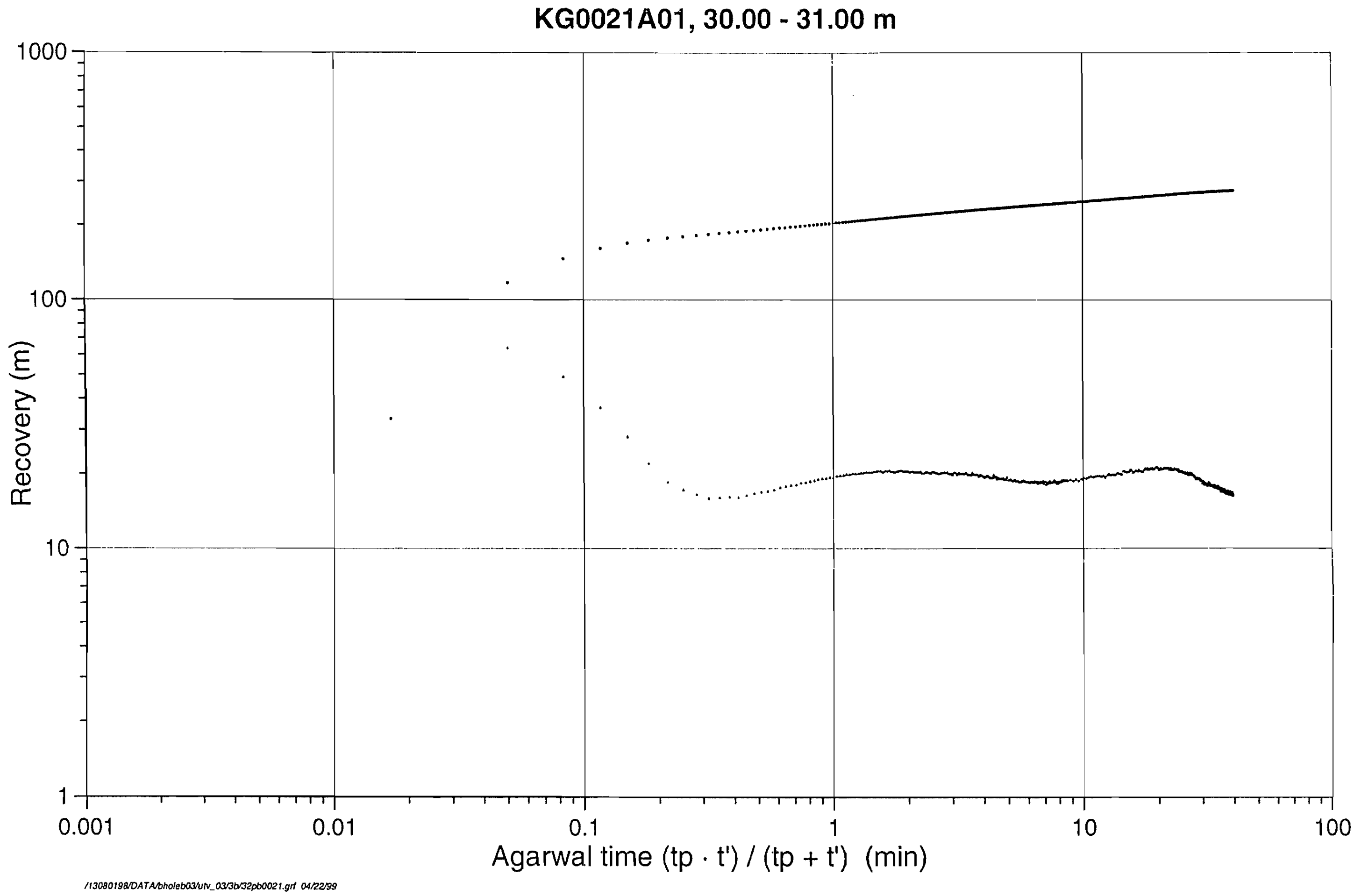


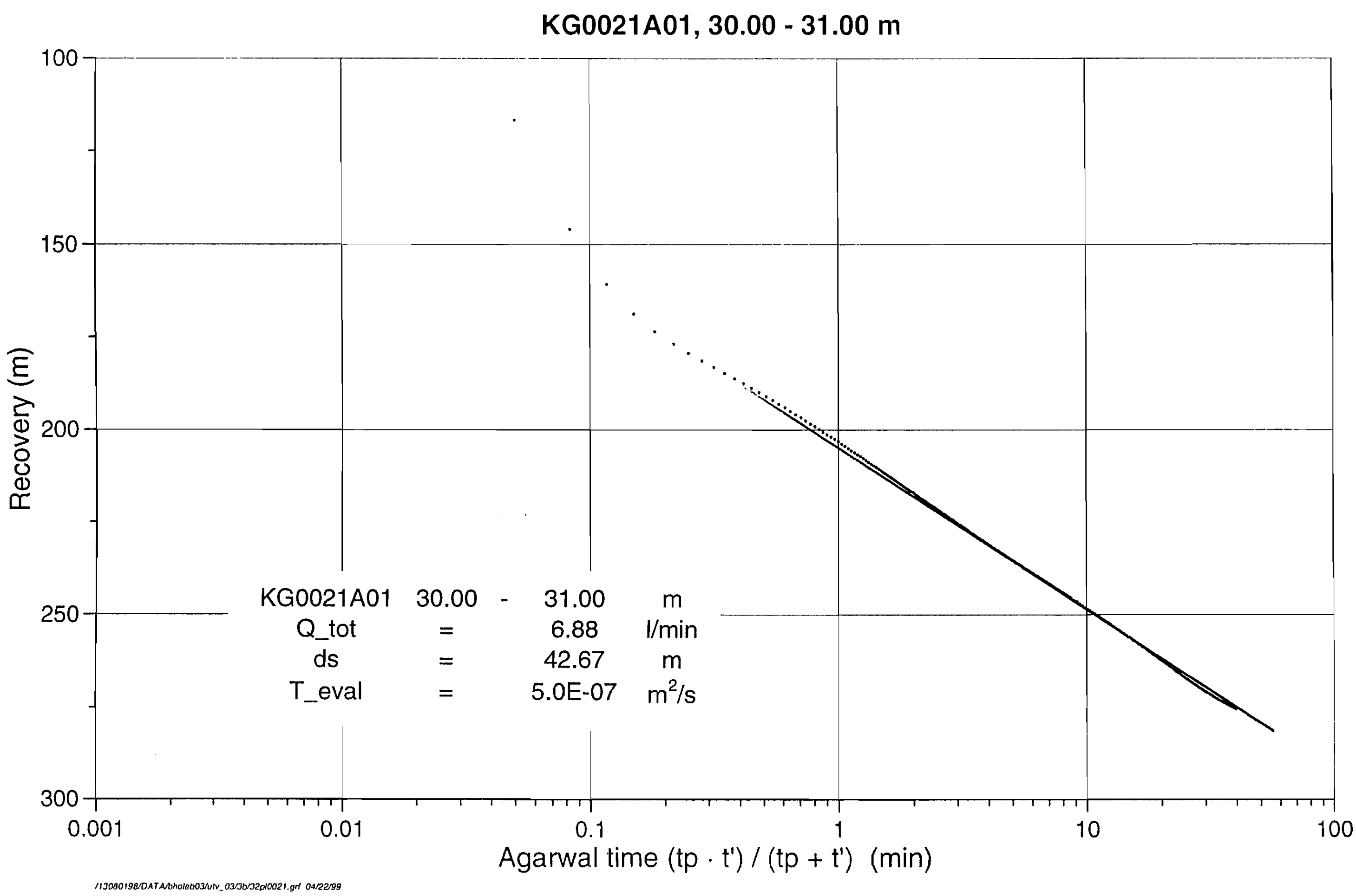
/13080198/DATA/bholeb03/utv_03/3b/31pb0021.grf 04/22/99

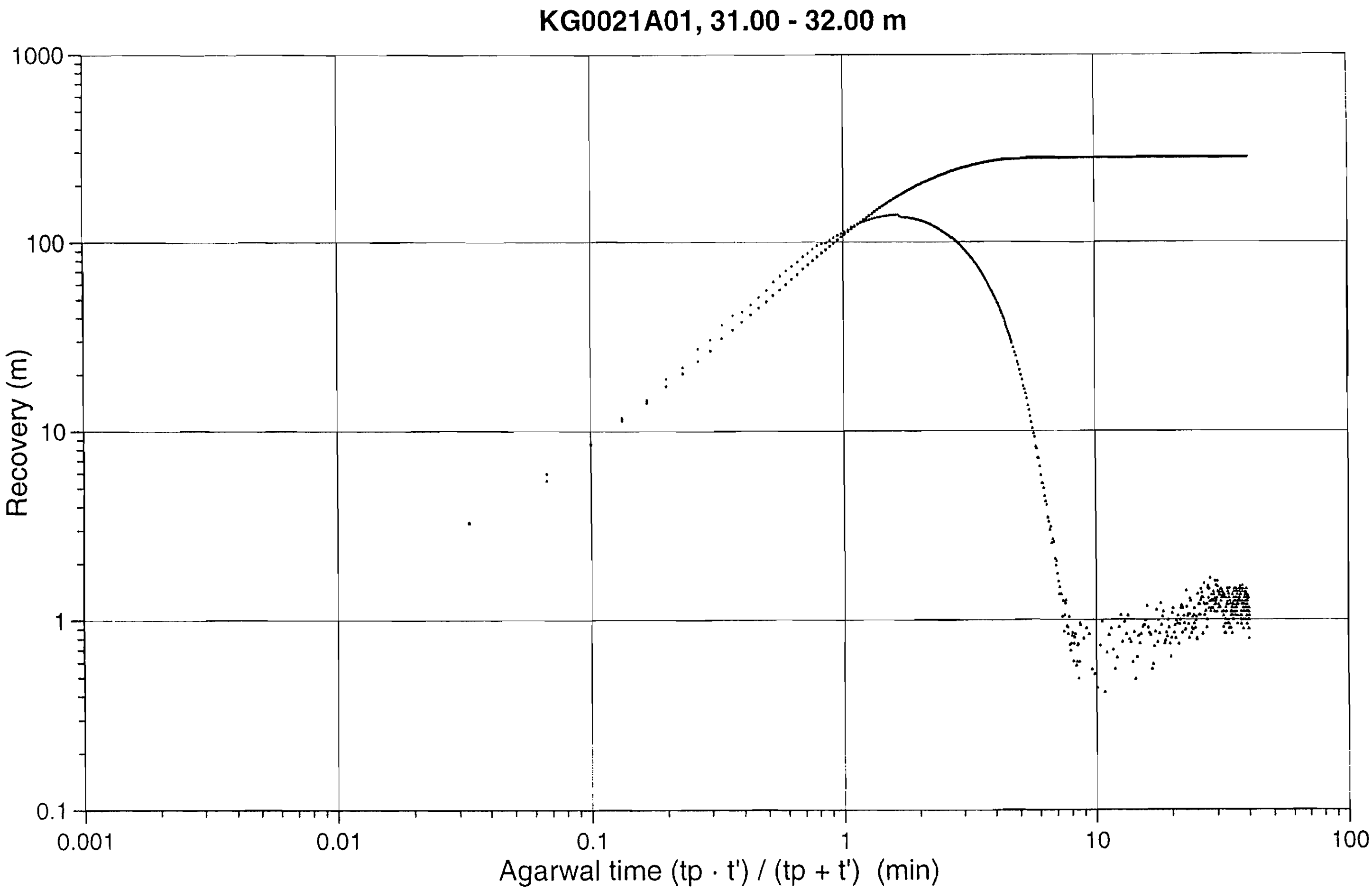
KG0021A01, 29.00 - 30.00 m



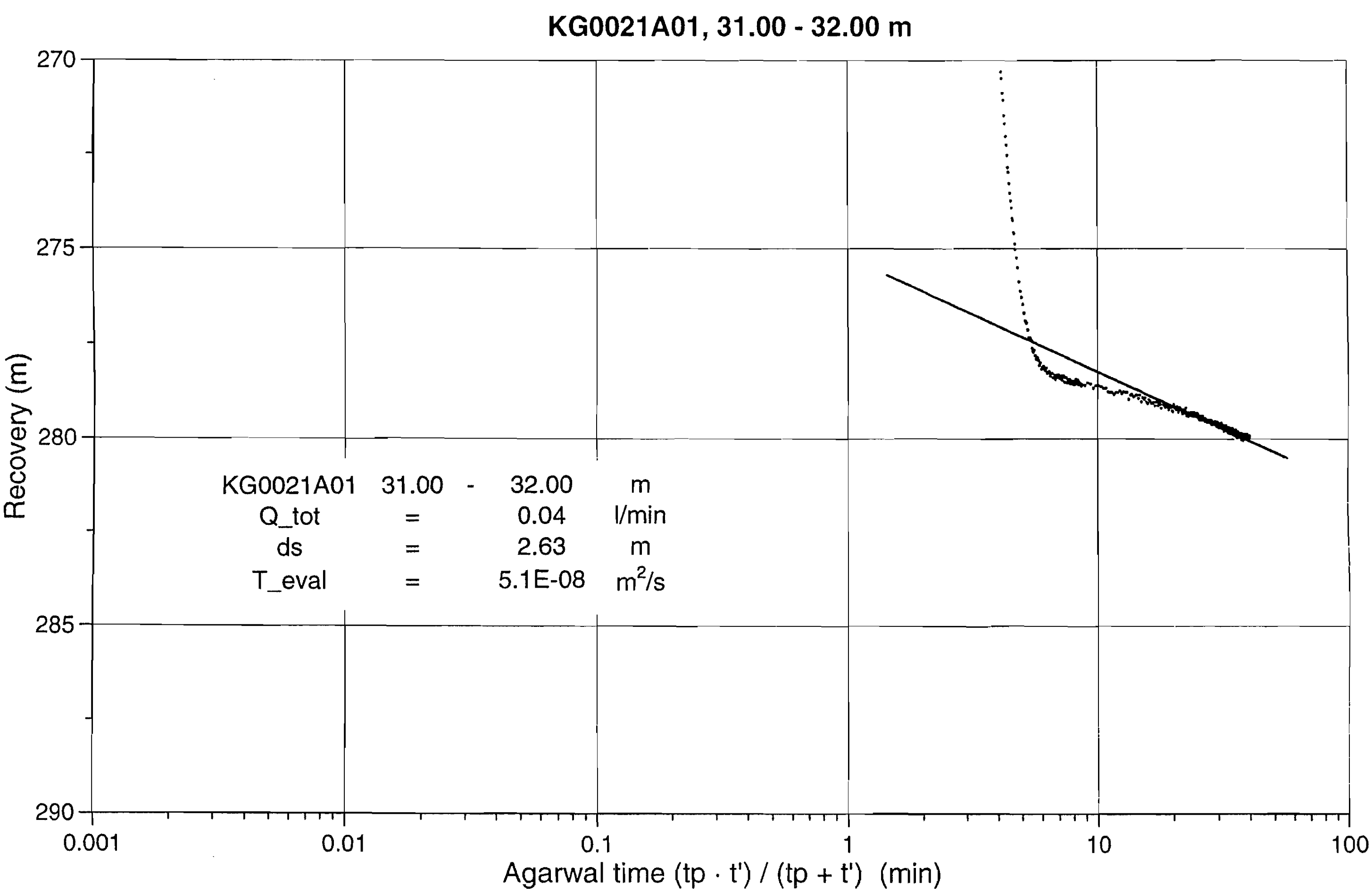
/13080198/DATA/bholeb03/utv_03/3b/31pl0021.grf 04/22/99


KG0021A01, 30.00 - 31.00 m
1000
100
10
1
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/32pb0021.grf 04/22/99

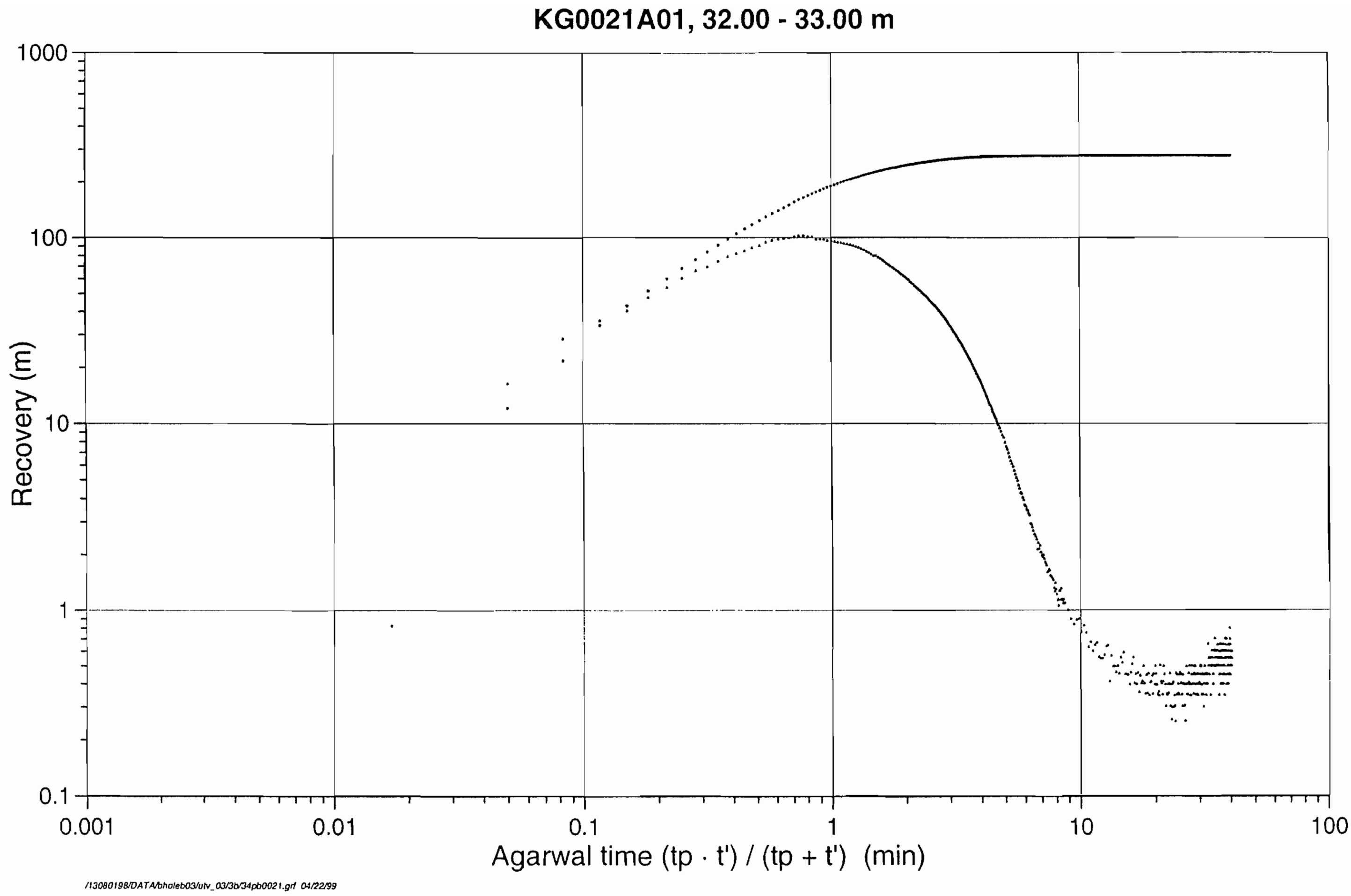

KG0021A01, 30.00 - 31.00 m
100
150
200
250
300
Recovery (m)
KG0021A01 30.00 - 31.00 m
Q_tot = 6.88 l/min
ds = 42.67 m
T_eval = 5.0E-07 m2/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/32pl0021.grf 04/22/99

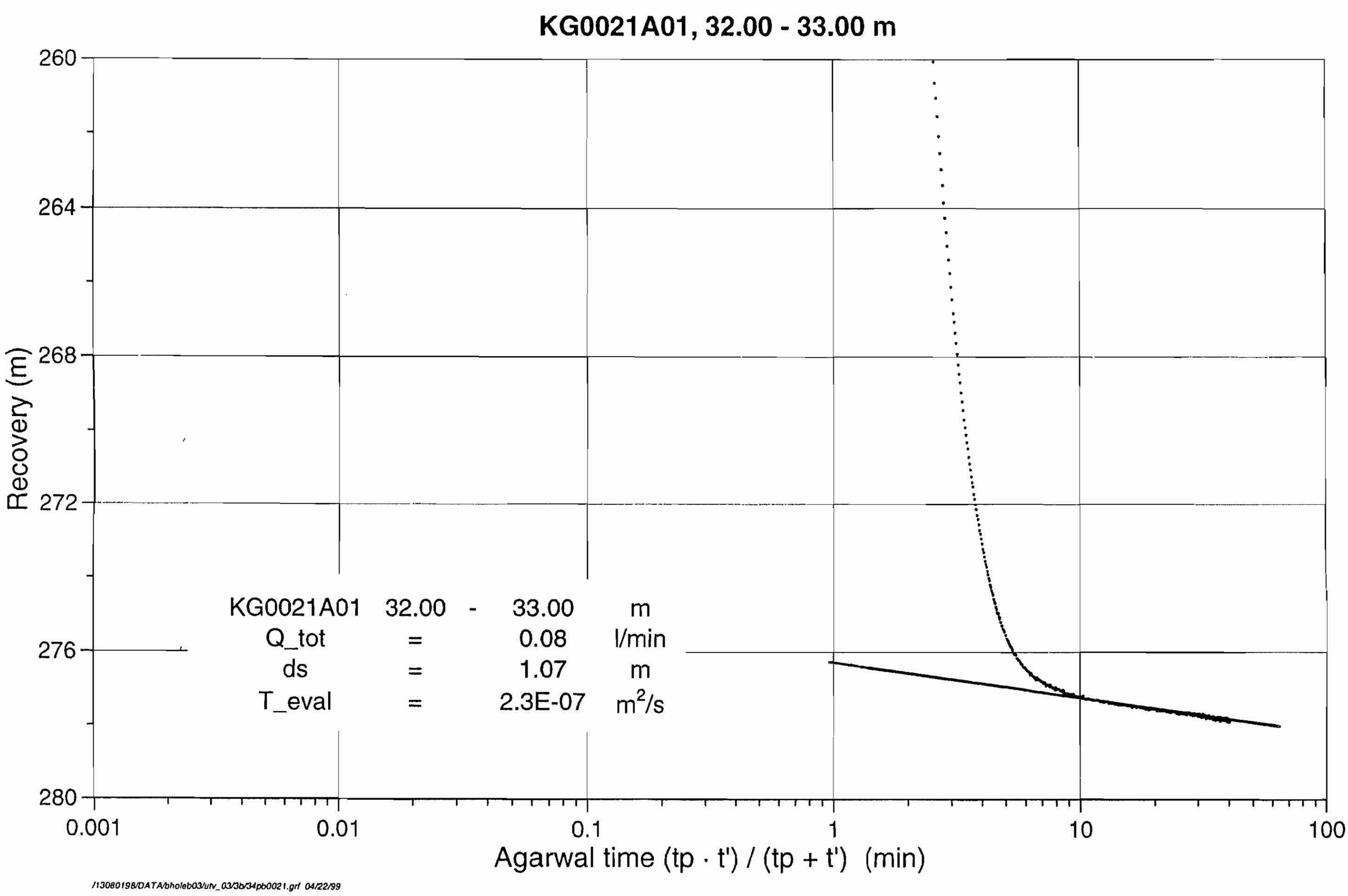


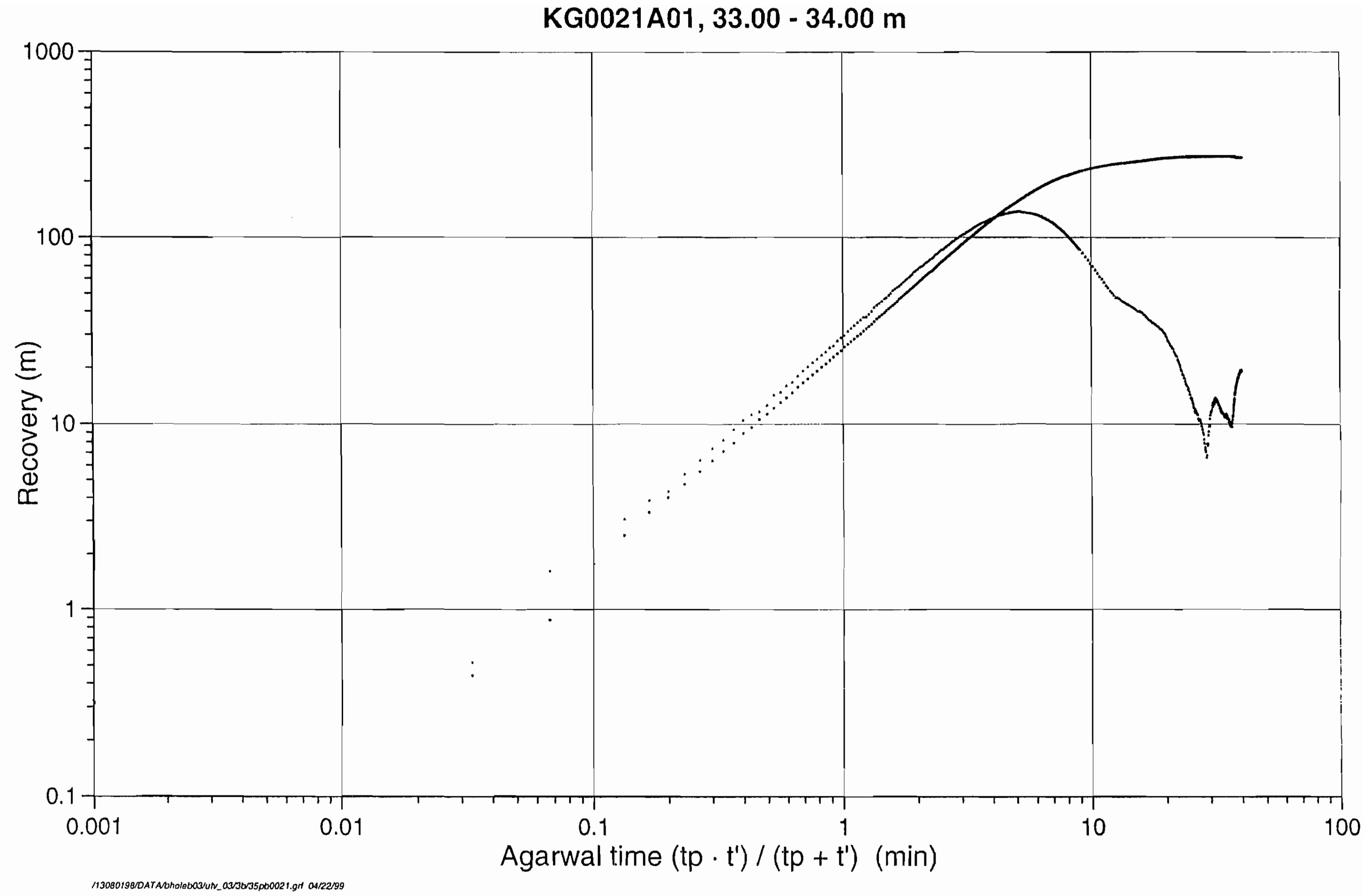
/13080198/DATA/bholeb03/utv_03/3b/33pb0021.grf 04/22/99

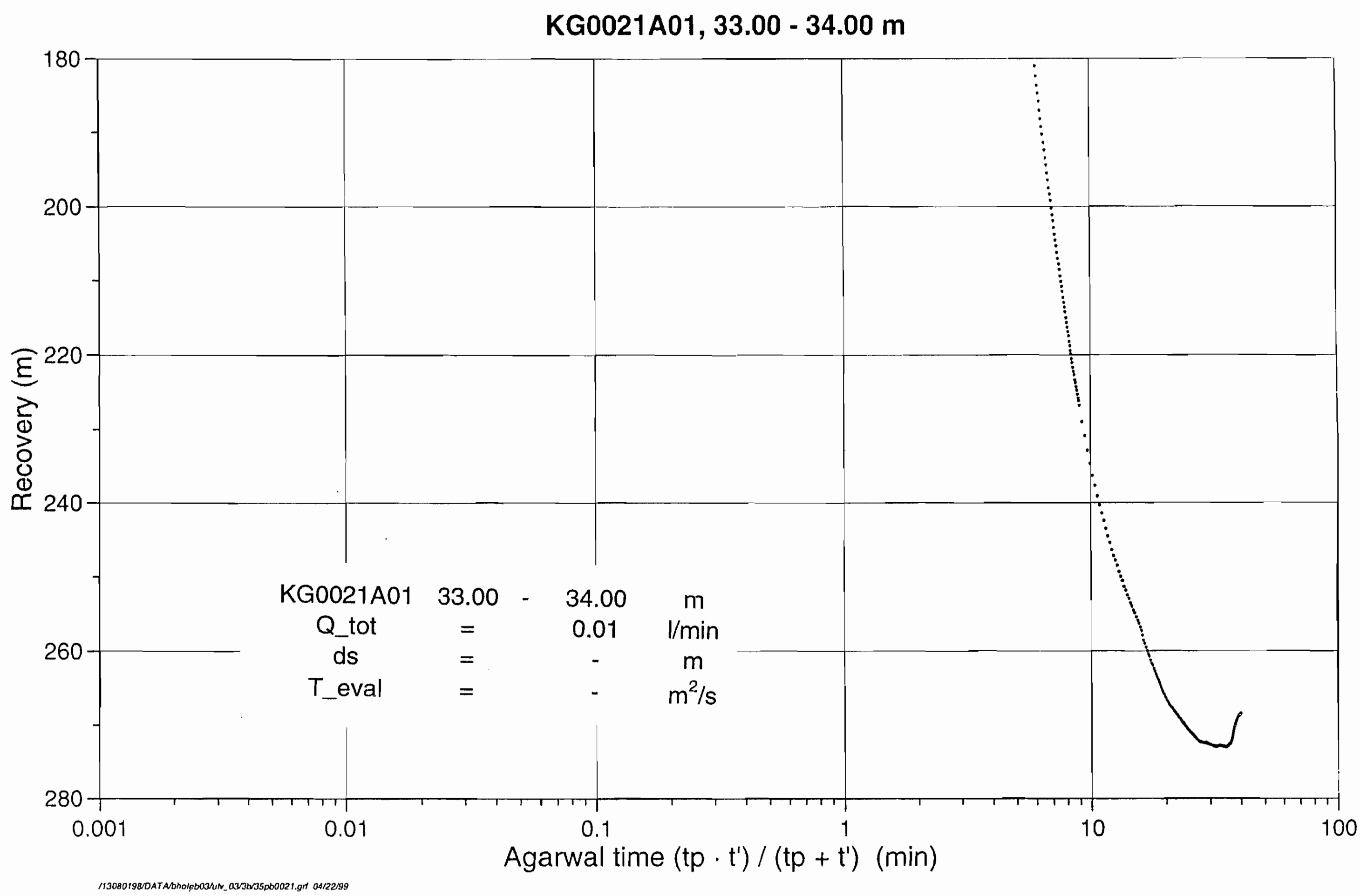


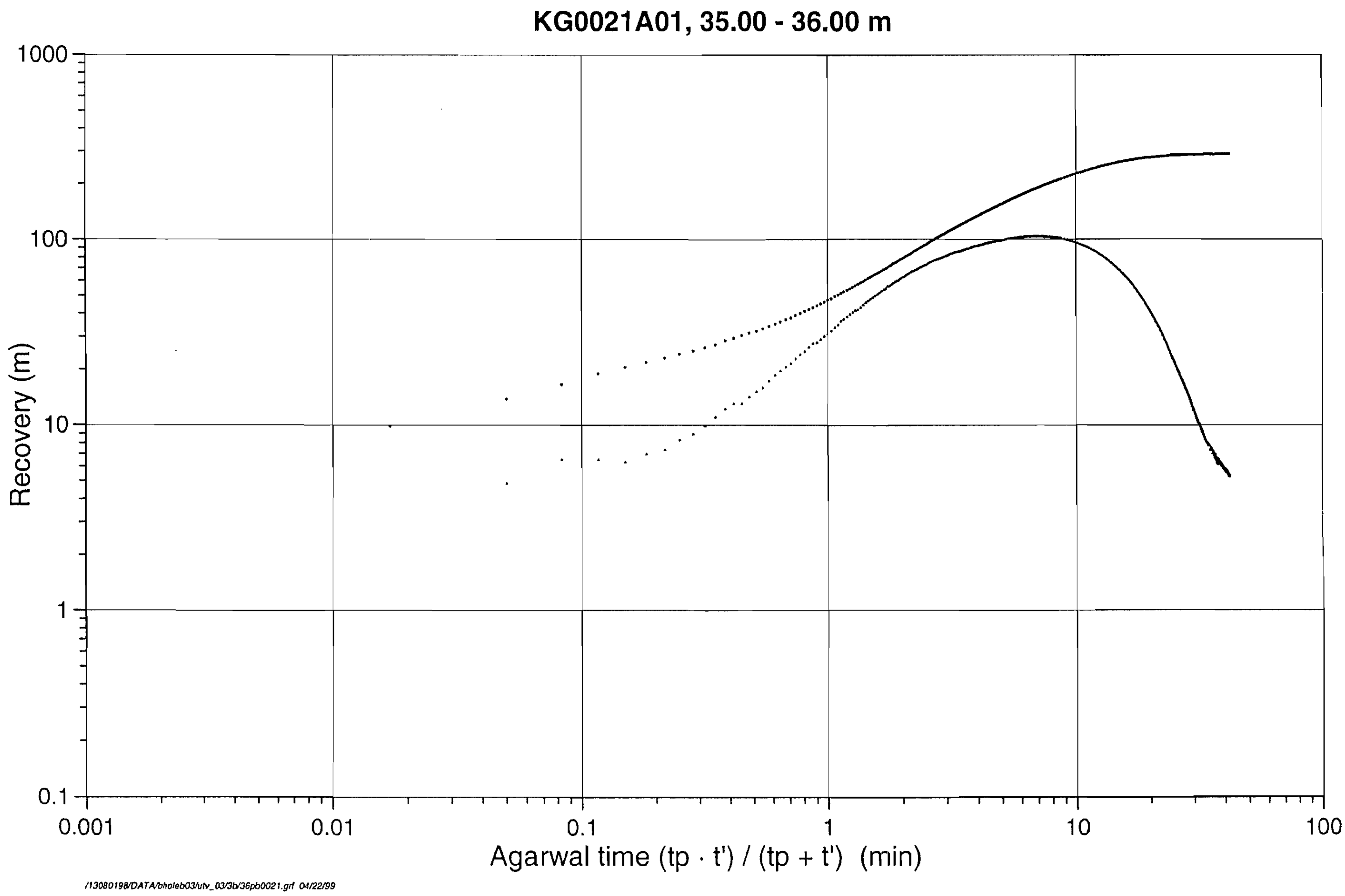
/13080198/DATA/bholeb03/utv_03/3b/33pl0021.grf 04/22/99

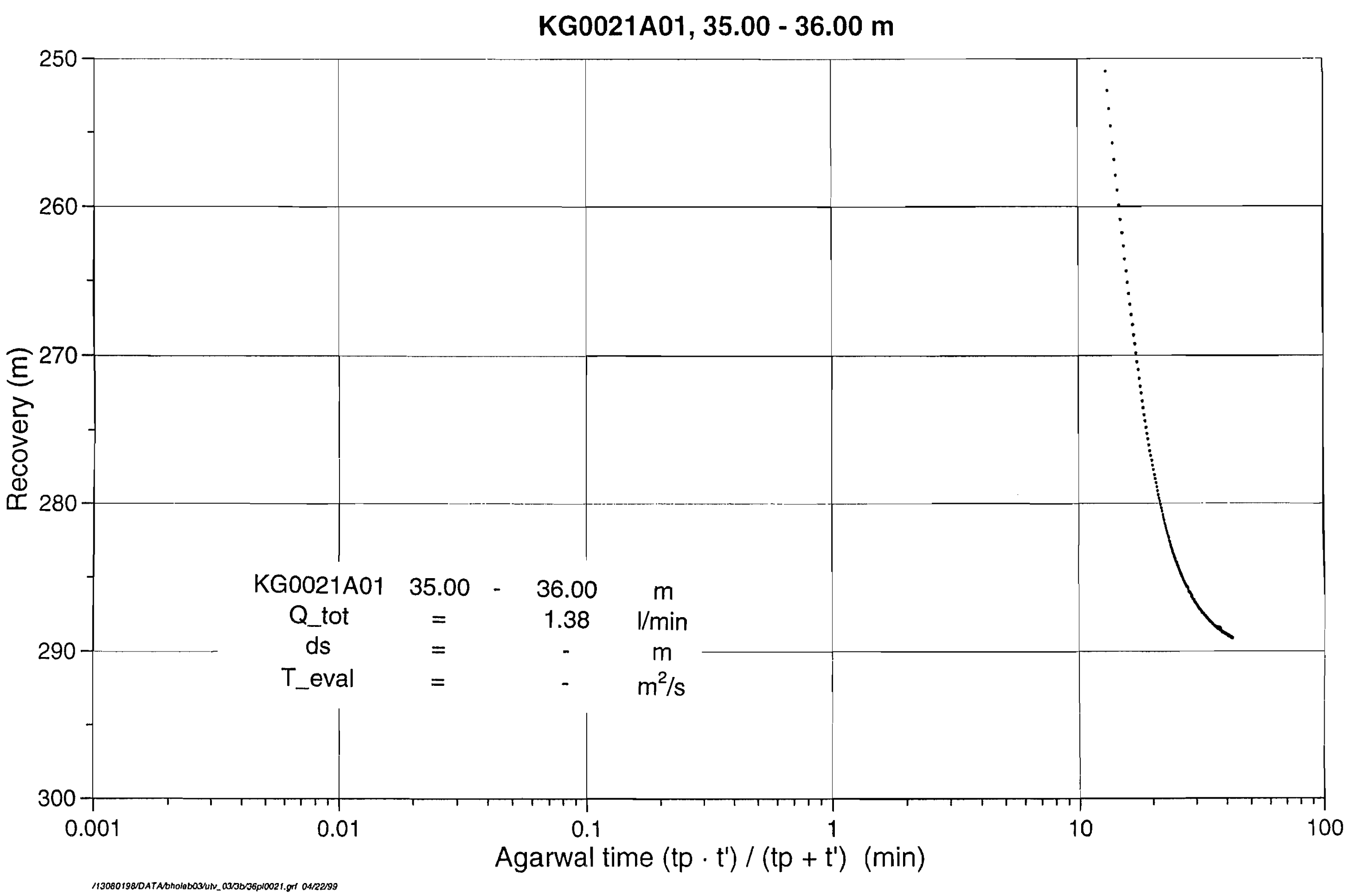

KG0021A01, 32.00 - 33.00 m
1000
100
10
1
0.1
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/34pb0021.grf 04/22/99


KG0021A01, 32.00 - 33.00 m
260
264
268
272
276
280
Recovery (m)
KG0021A01 32.00 - 33.00 m
Q_tot = 0.08 l/min
ds = 1.07 m
T_eval = 2.3E-07 m²/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/34pb0021.grf 04/22/99

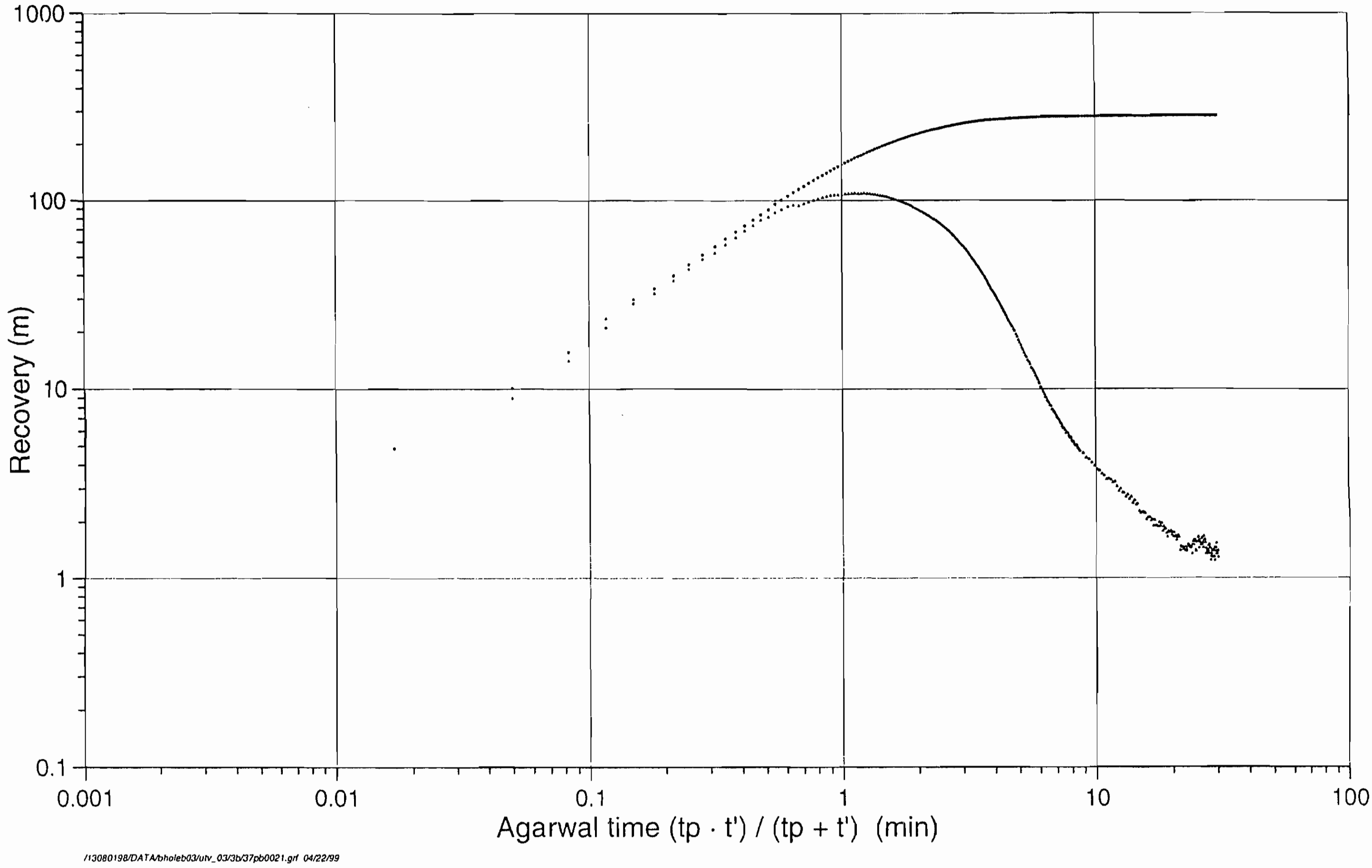

KG0021A01, 33.00 - 34.00 m
1000
100
10
1
0.1
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/ulv_03/3b/35pb0021.grf 04/22/99


KG0021A01, 33.00 - 34.00 m
180
200
220
240
260
280
Recovery (m)
KG0021A01 33.00 - 34.00 m
Q_tot = 0.01 l/min
ds = - m
T_eval = - m²/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/ulv_03/3b/35pb0021.grf 04/22/99

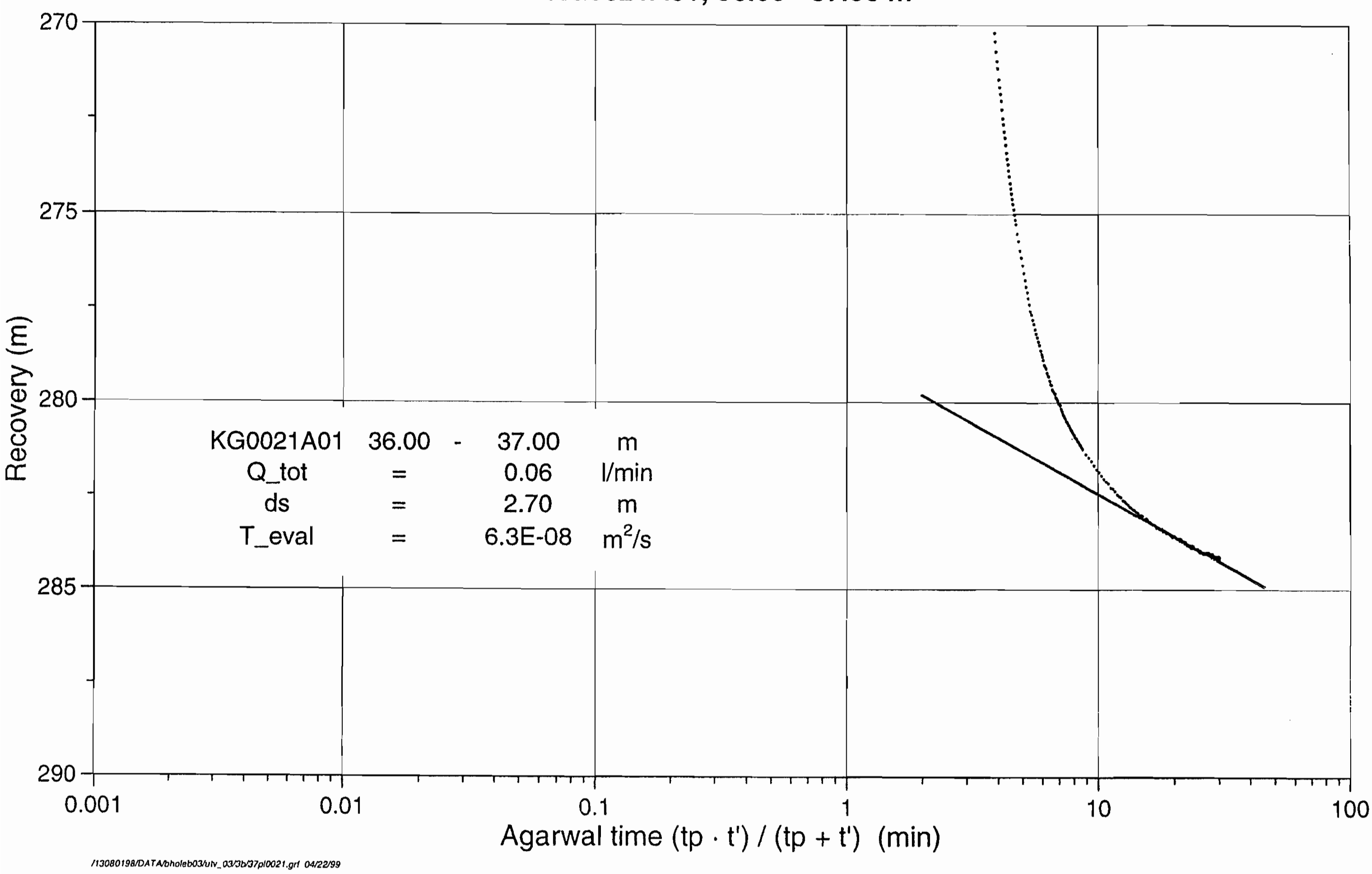

KG0021A01, 35.00 - 36.00 m
1000
100
10
1
0.1
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/36pb0021.grf 04/22/99

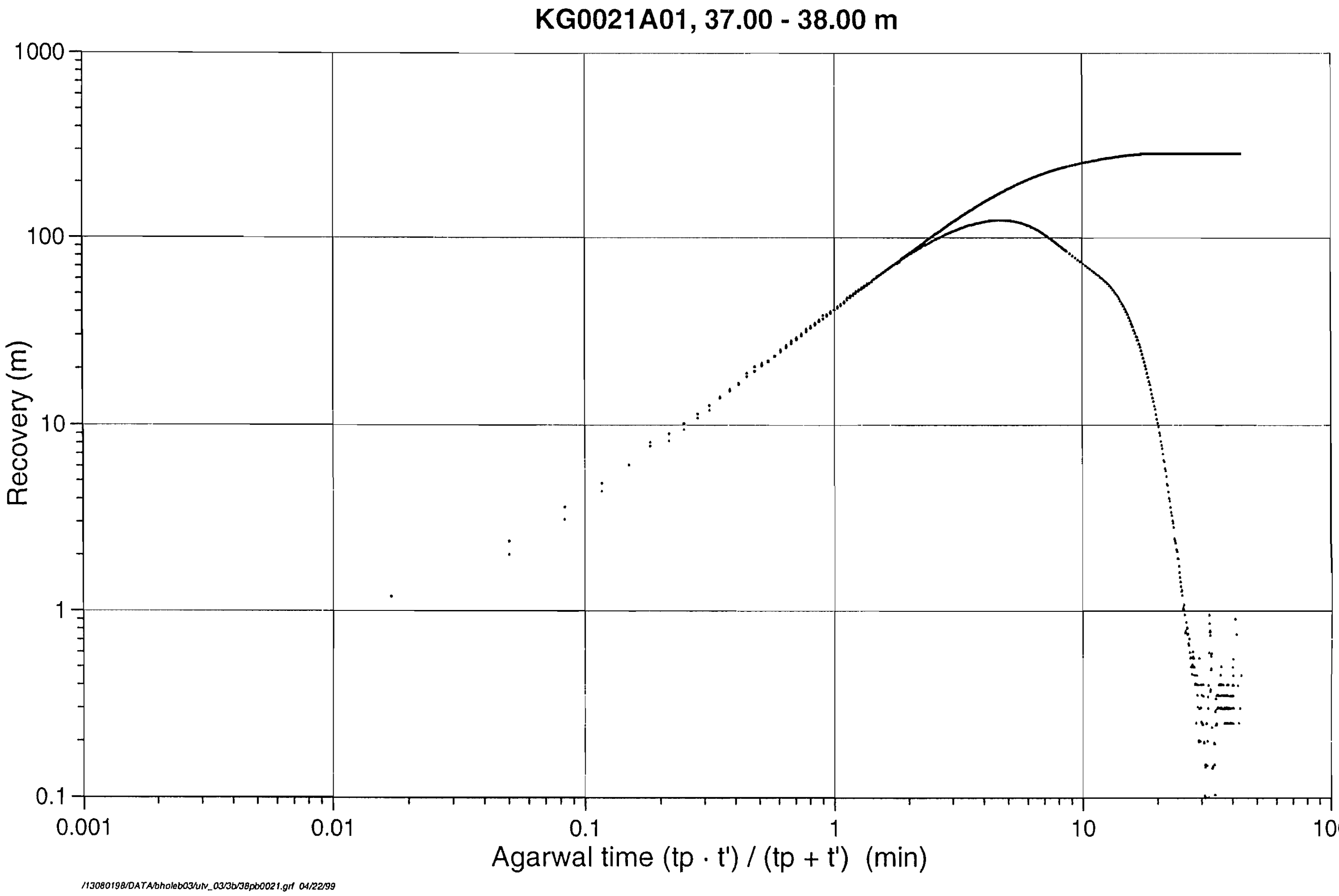

KG0021A01, 35.00 - 36.00 m
250
260
270
280
290
300
Recovery (m)
KG0021A01 35.00 - 36.00 m
Q_tot = 1.38 l/min
ds = - m
T_eval = - m²/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/36pl0021.grf 04/22/99

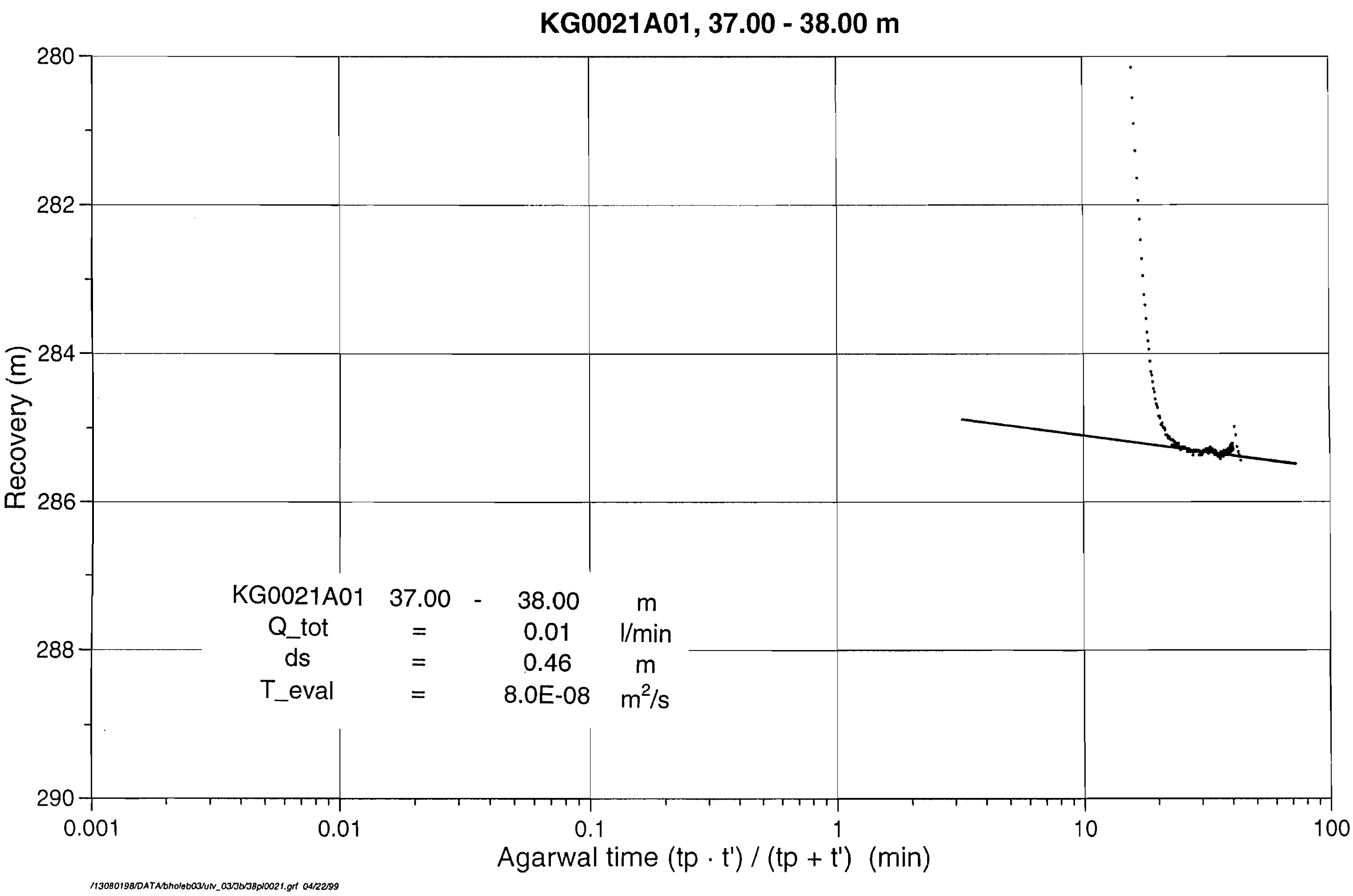
KG0021A01, 36.00 - 37.00 m



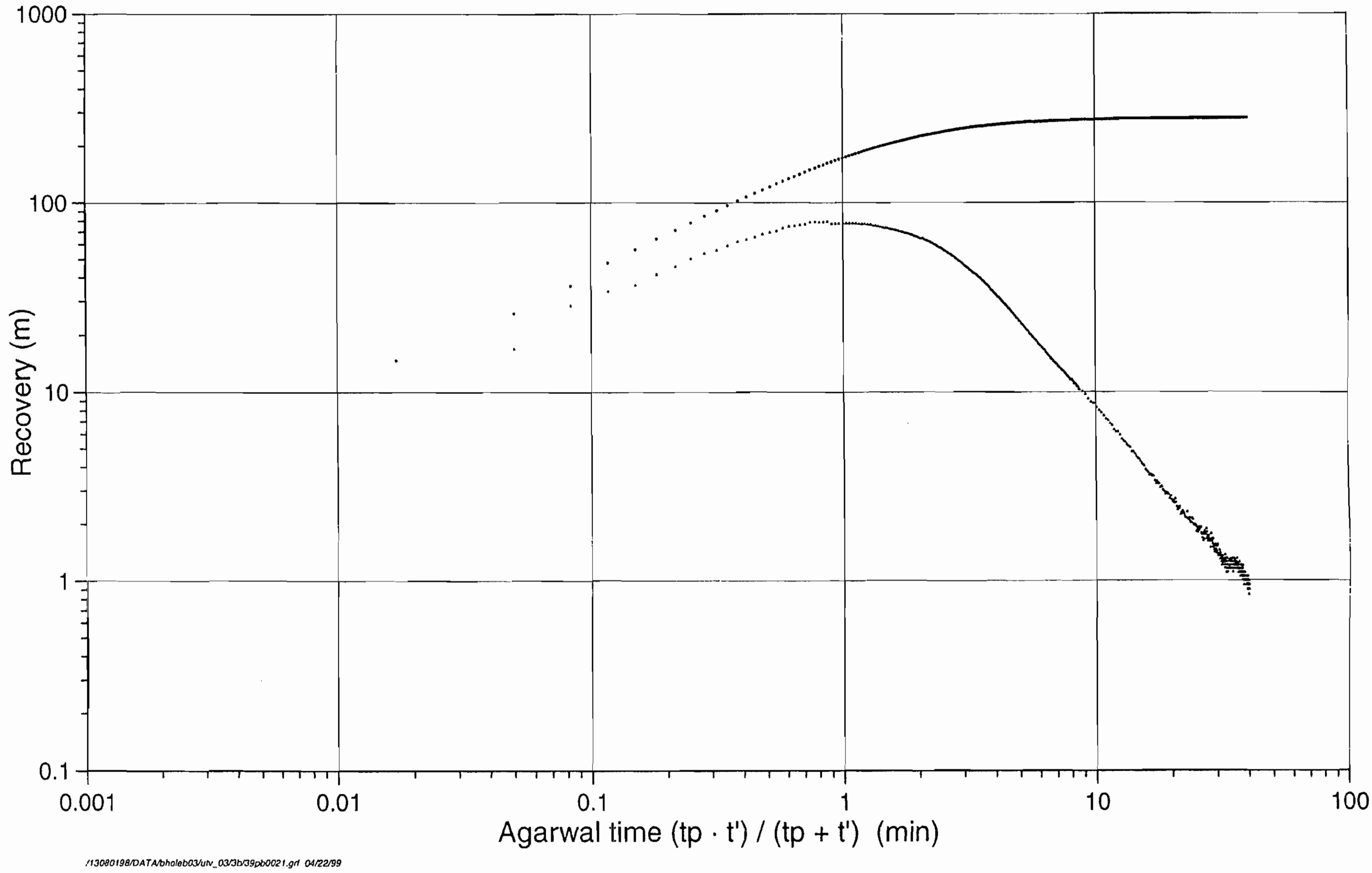
KG0021A01, 36.00 - 37.00 m



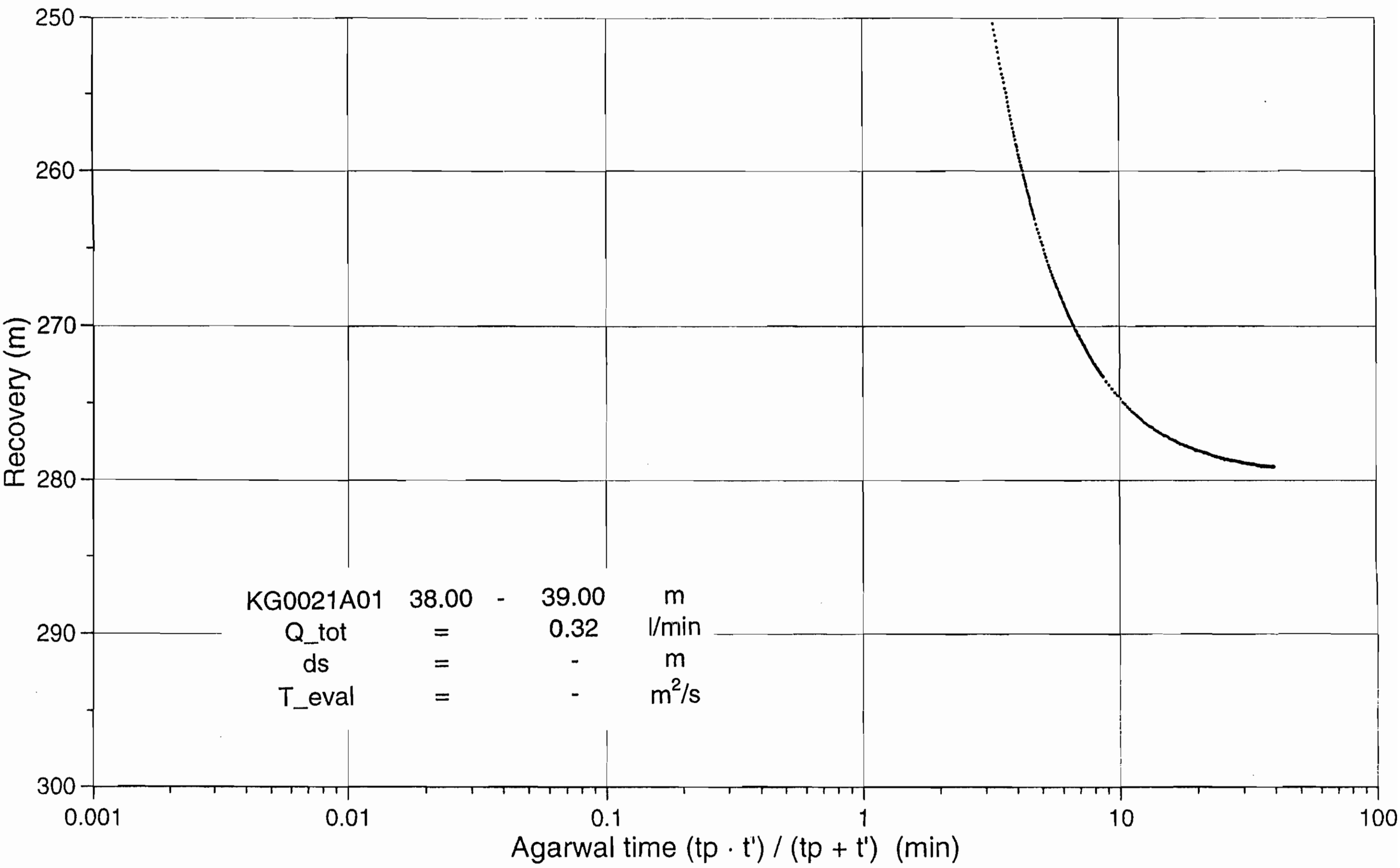

KG0021A01, 37.00 - 38.00 m
Recovery (m)
Agarwal time (tp · t') / (tp + t') (min)
1000
100
10
1
0.1
0.001
0.01
0.1
1
10
100
/13080198/DATA/bholeb03/utv_03/3b/38pb0021.grf 04/22/99

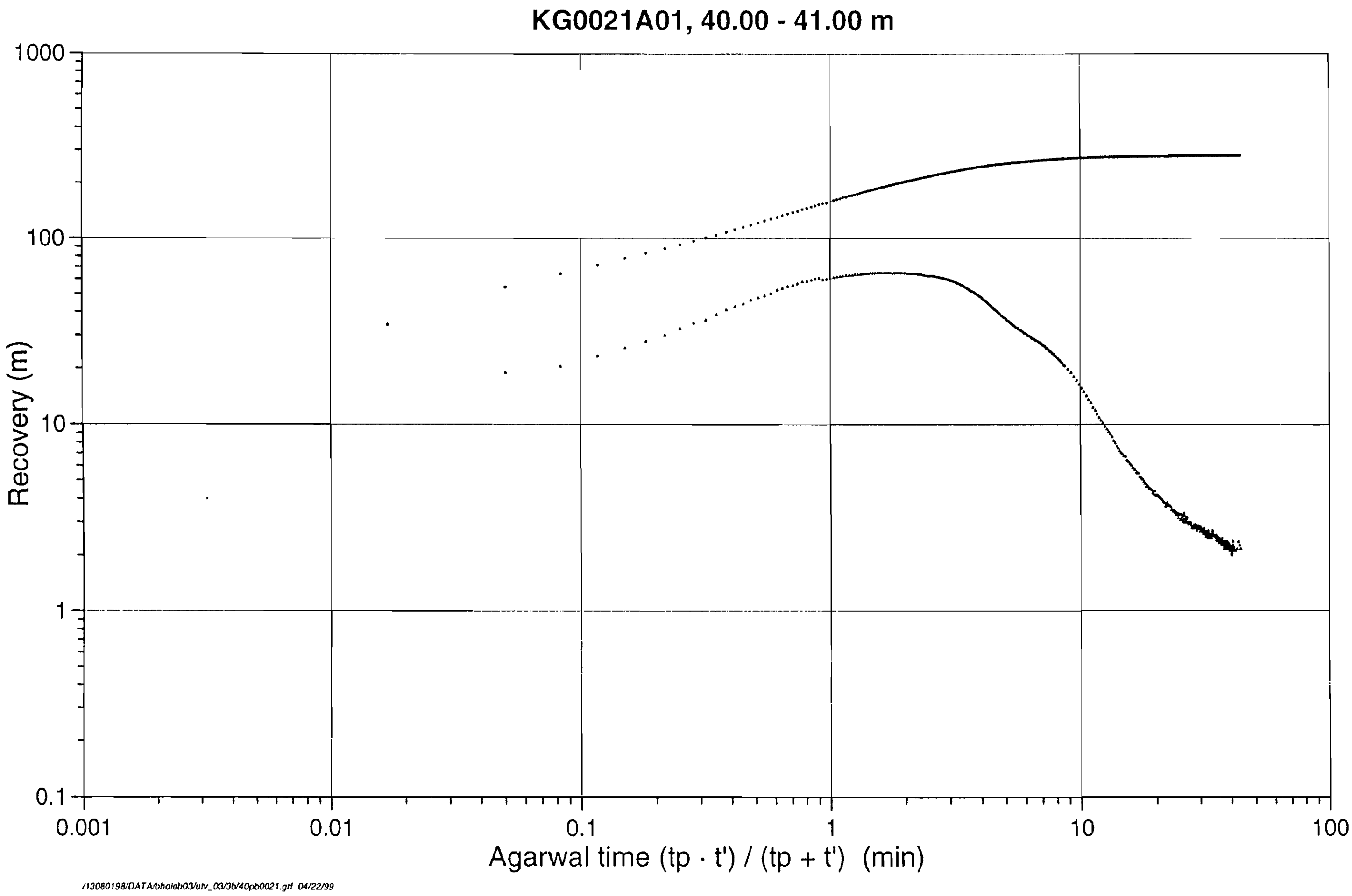

KG0021A01, 37.00 - 38.00 m
Recovery (m)
Agarwal time (tp · t') / (tp + t') (min)
280
282
284
286
288
290
0.001
0.01
0.1
1
10
100
KG0021A01 37.00 - 38.00 m
Q_tot = 0.01 l/min
ds = 0.46 m
T_eval = 8.0E-08 m2/s
/13080198/DATA/bholeb03/utv_03/3b/38pl0021.grf 04/22/99

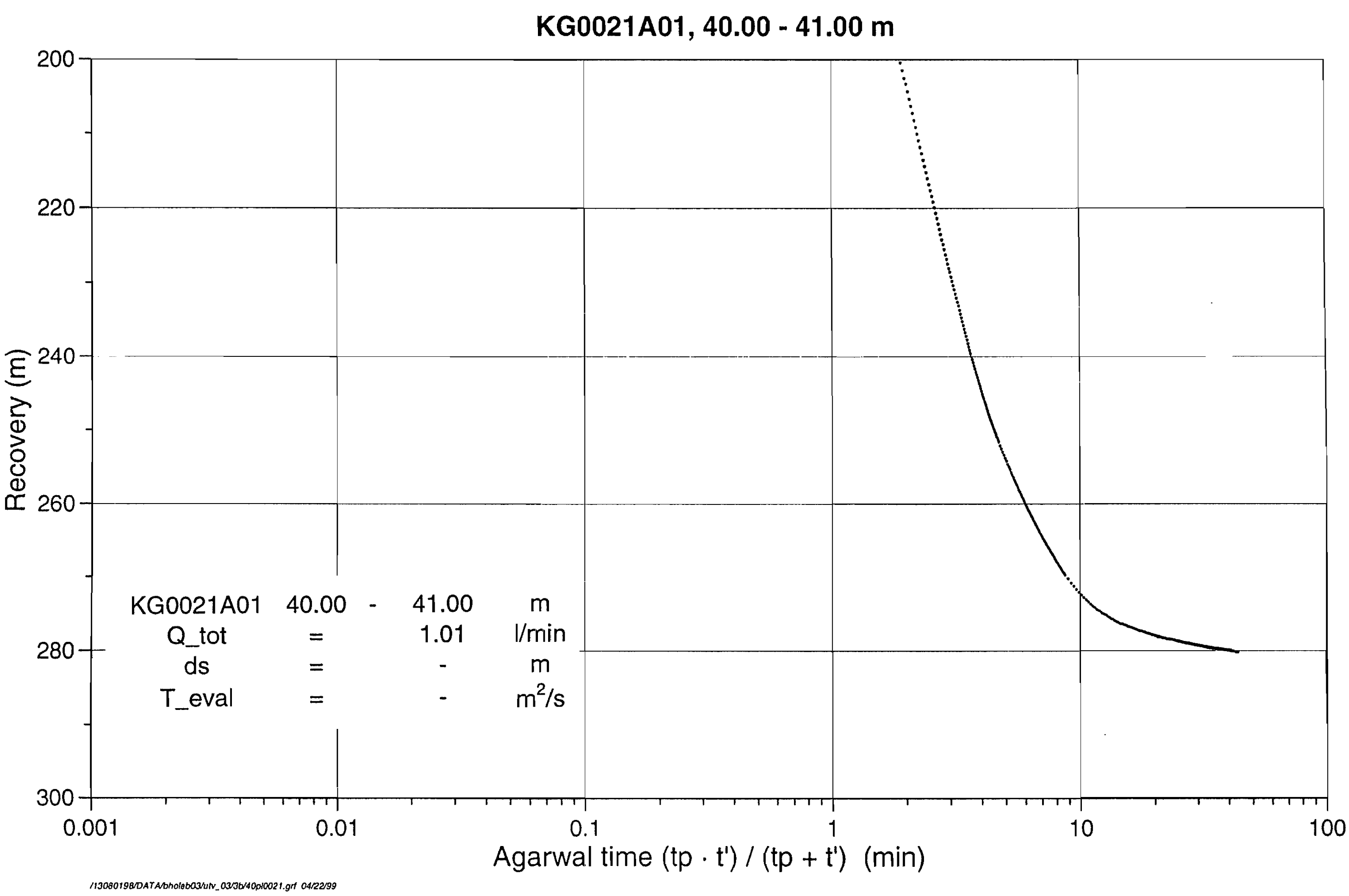
KG0021A01, 38.00 - 39.00 m



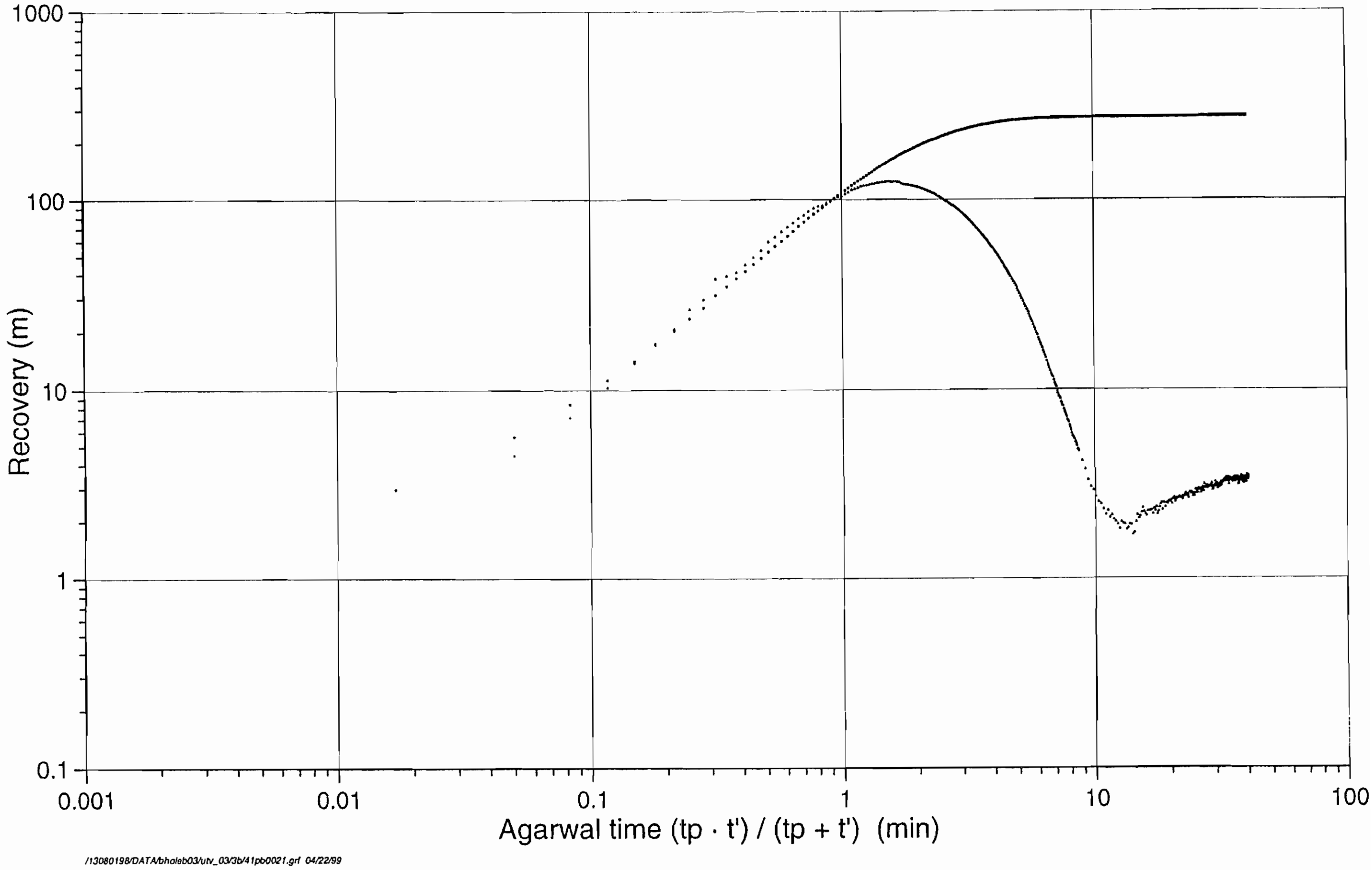
KG0021A01, 38.00 - 39.00 m



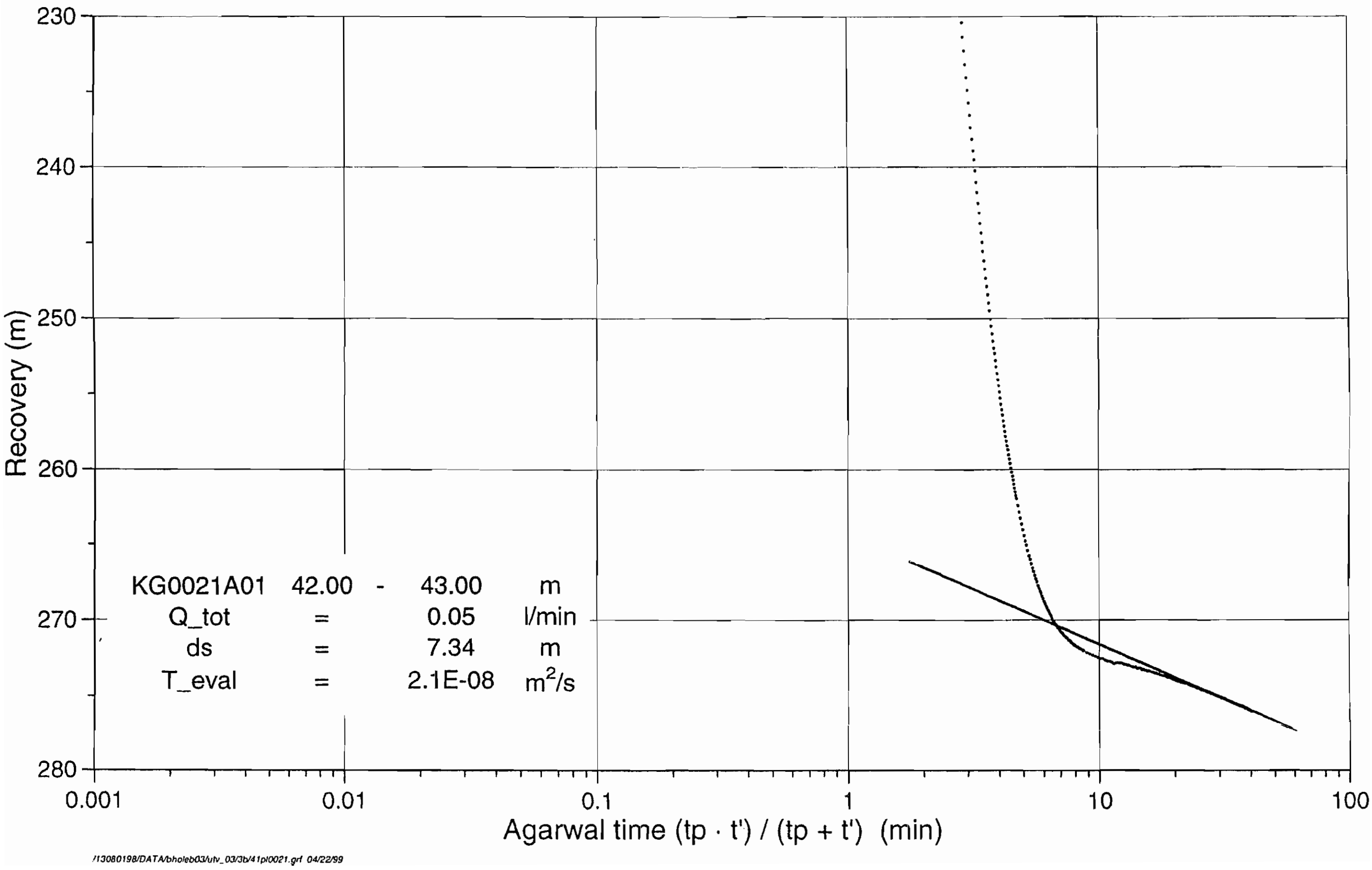

KG0021A01, 40.00 - 41.00 m
1000
100
10
1
0.1
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)

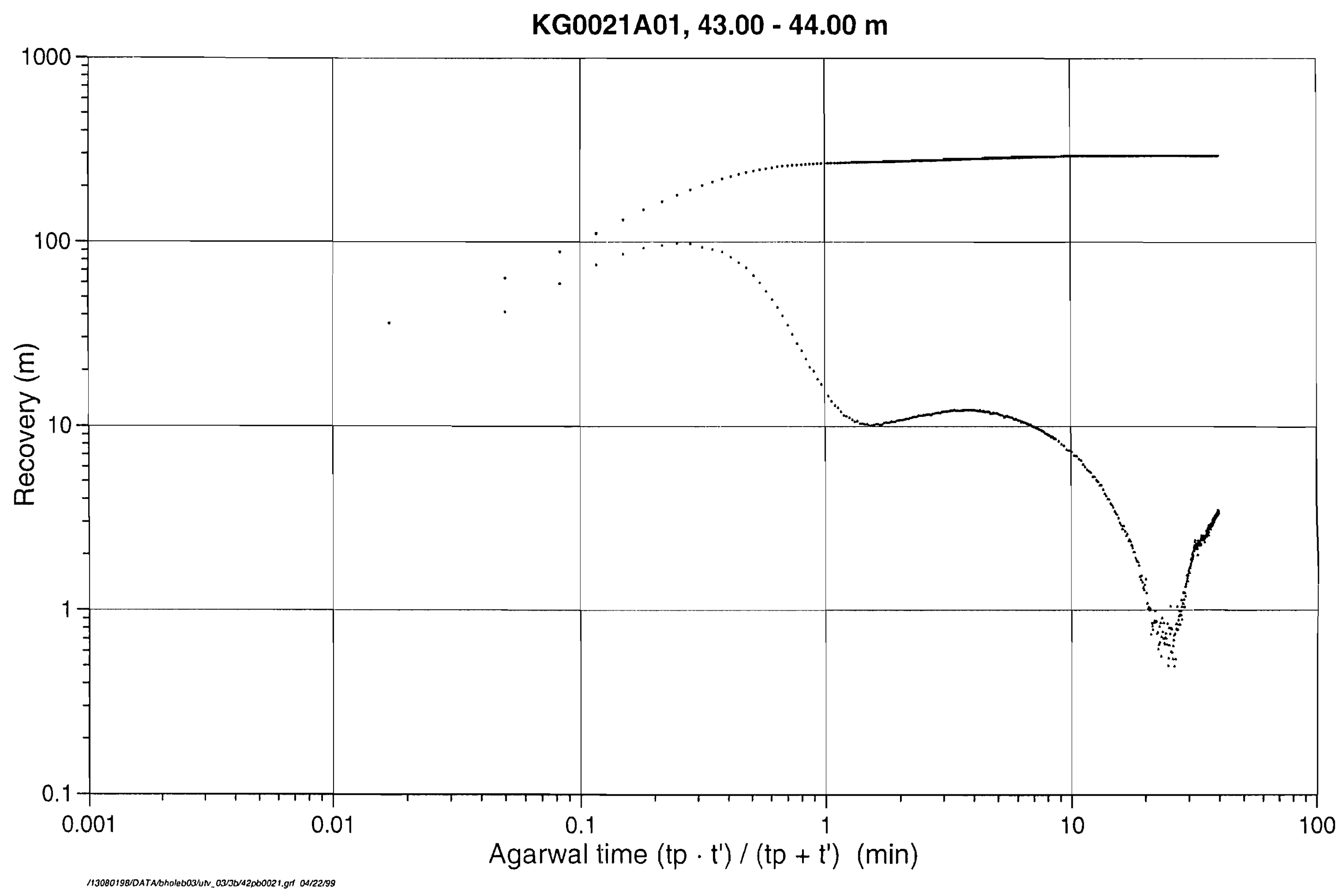

KG0021A01, 40.00 - 41.00 m
200
220
240
260
280
300
Recovery (m)
KG0021A01 40.00 - 41.00 m
Q_tot = 1.01 l/min
ds = - m
T_eval = - m2/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)

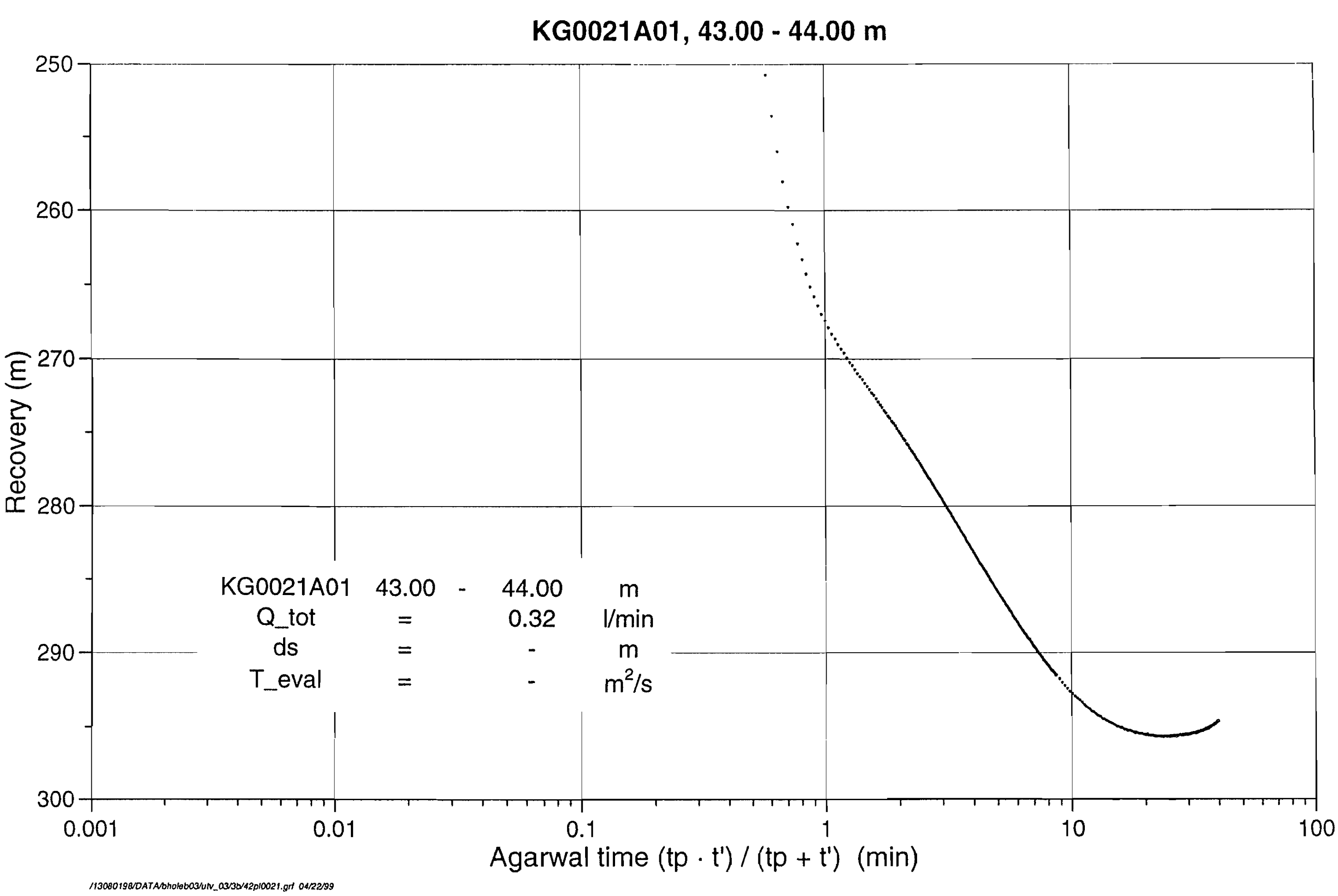
KG0021A01, 42.00 - 43.00 m



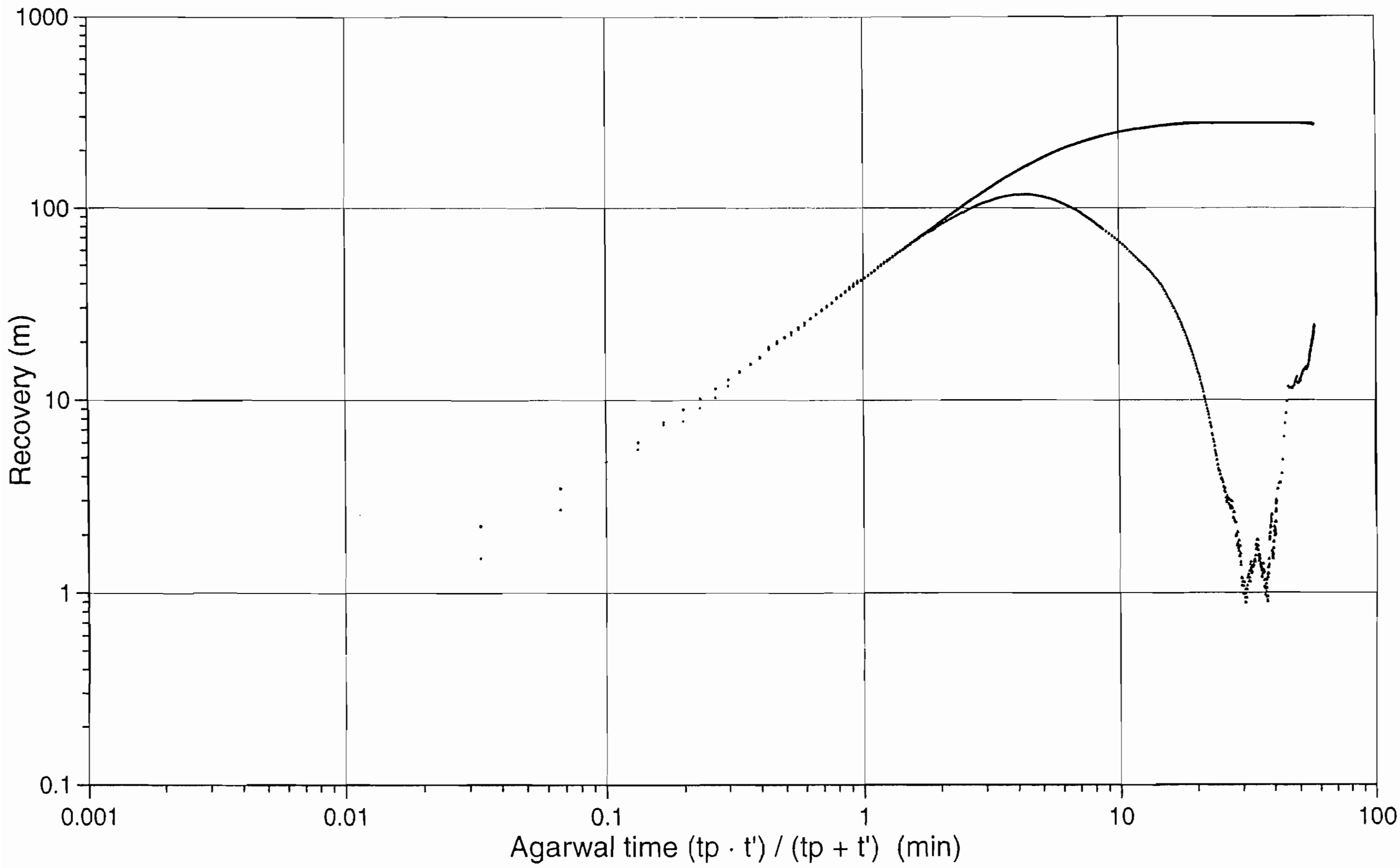
KG0021A01, 42.00 - 43.00 m



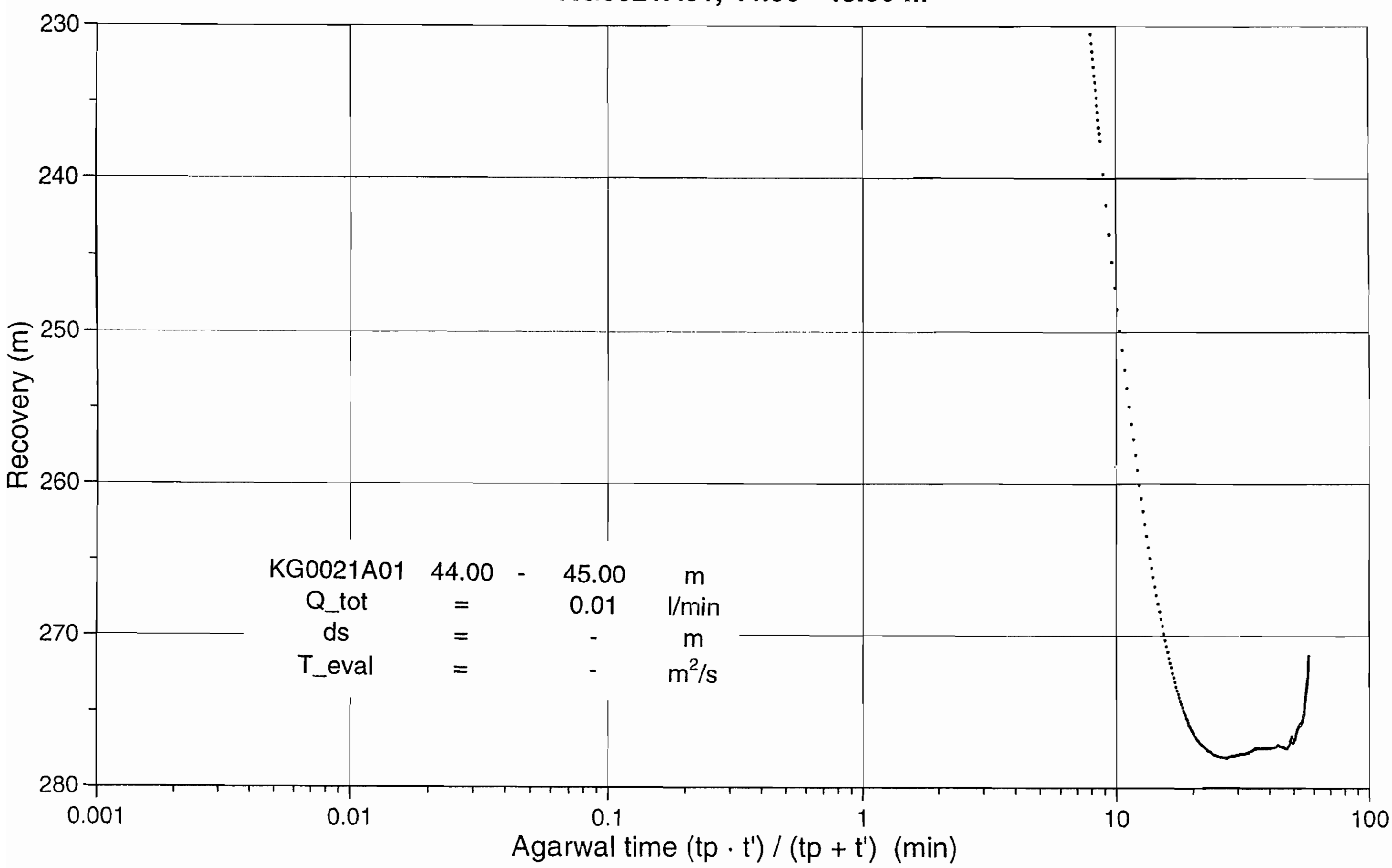

KG0021A01, 43.00 - 44.00 m
1000
100
10
1
0.1
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/42pb0021.grf 04/22/99

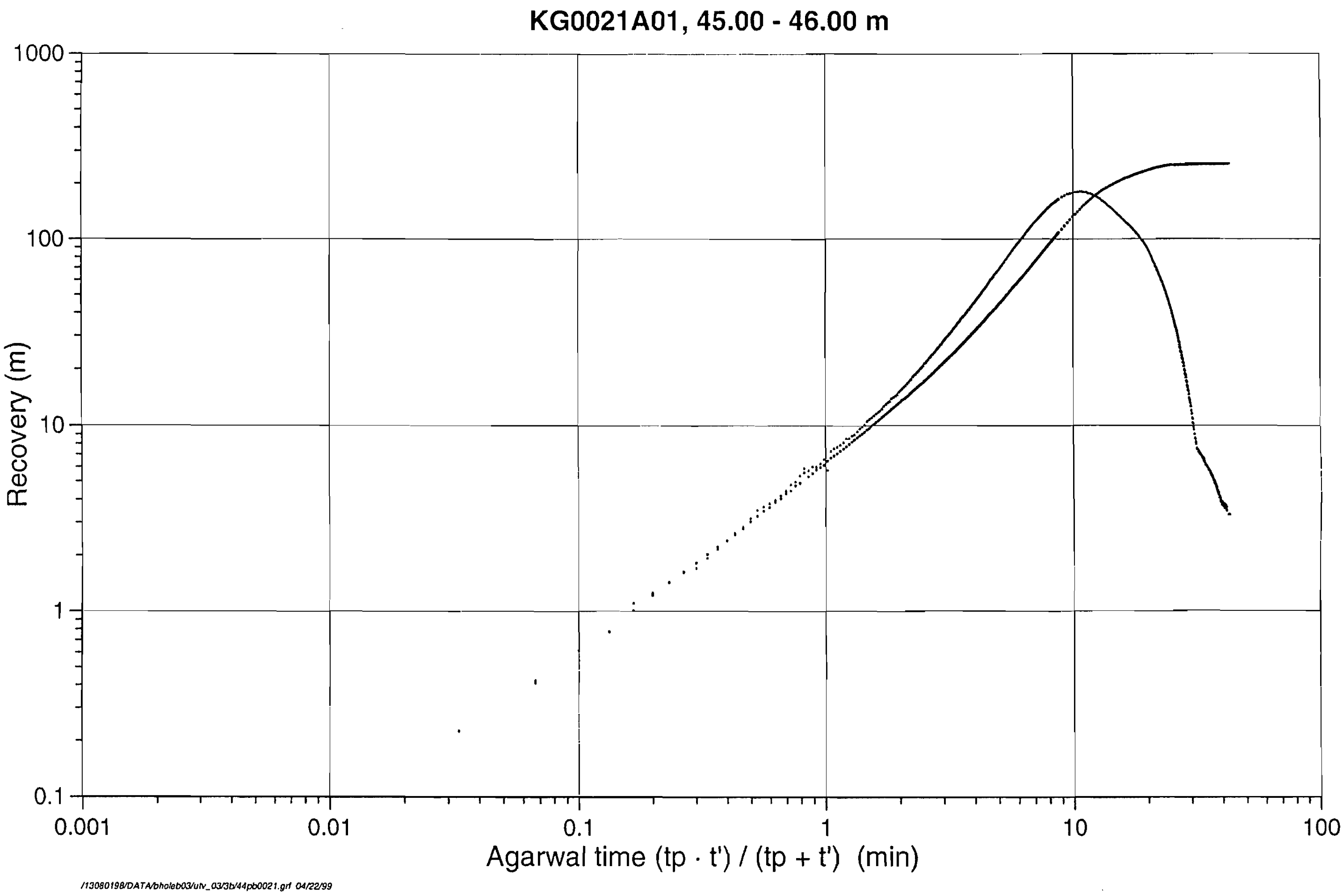

KG0021A01, 43.00 - 44.00 m
250
260
270
280
290
300
Recovery (m)
KG0021A01 43.00 - 44.00 m
Q_tot = 0.32 l/min
ds = - m
T_eval = - m2/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/42pl0021.grf 04/22/99

KG0021A01, 44.00 - 45.00 m

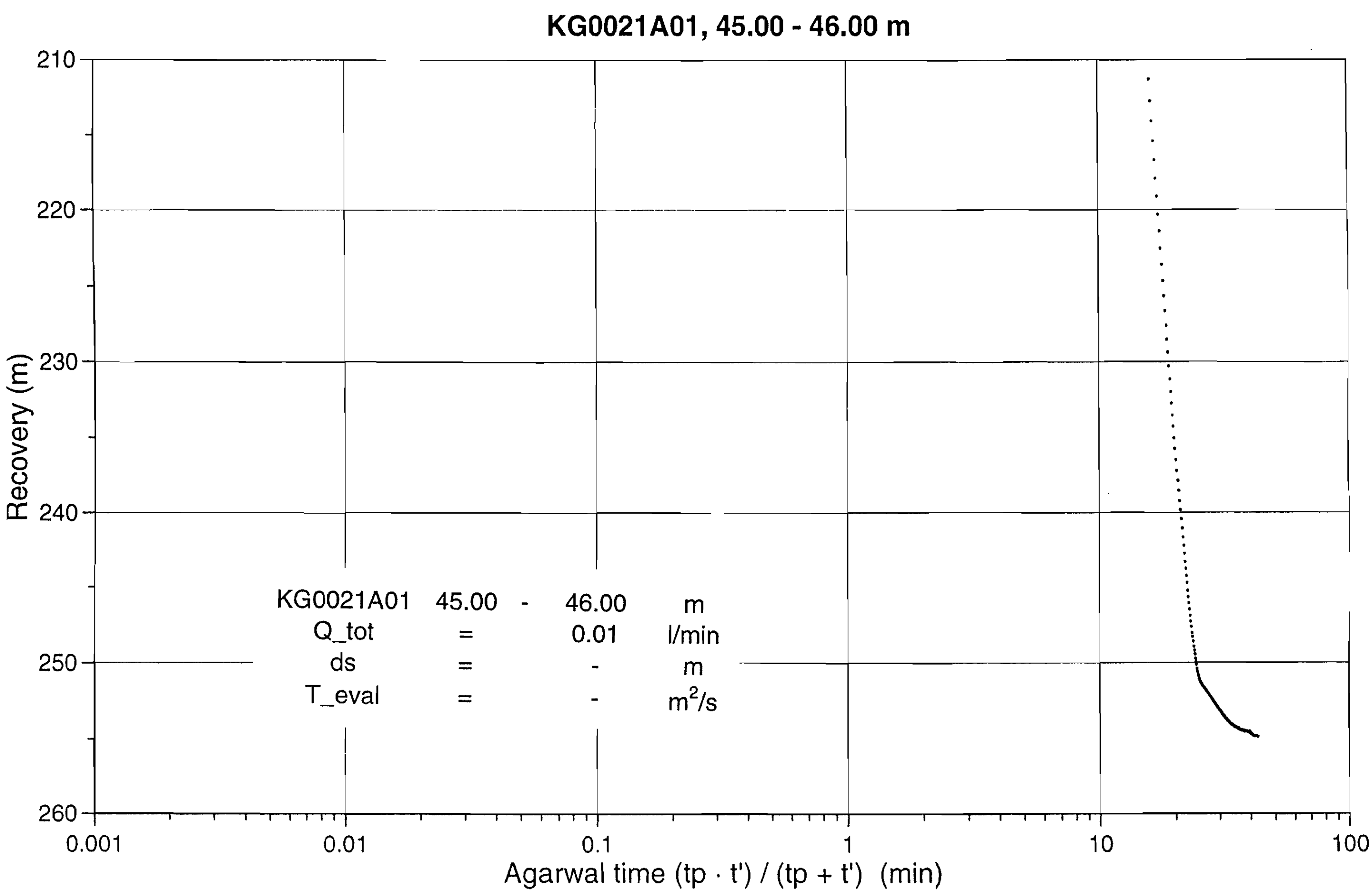


KG0021A01, 44.00 - 45.00 m

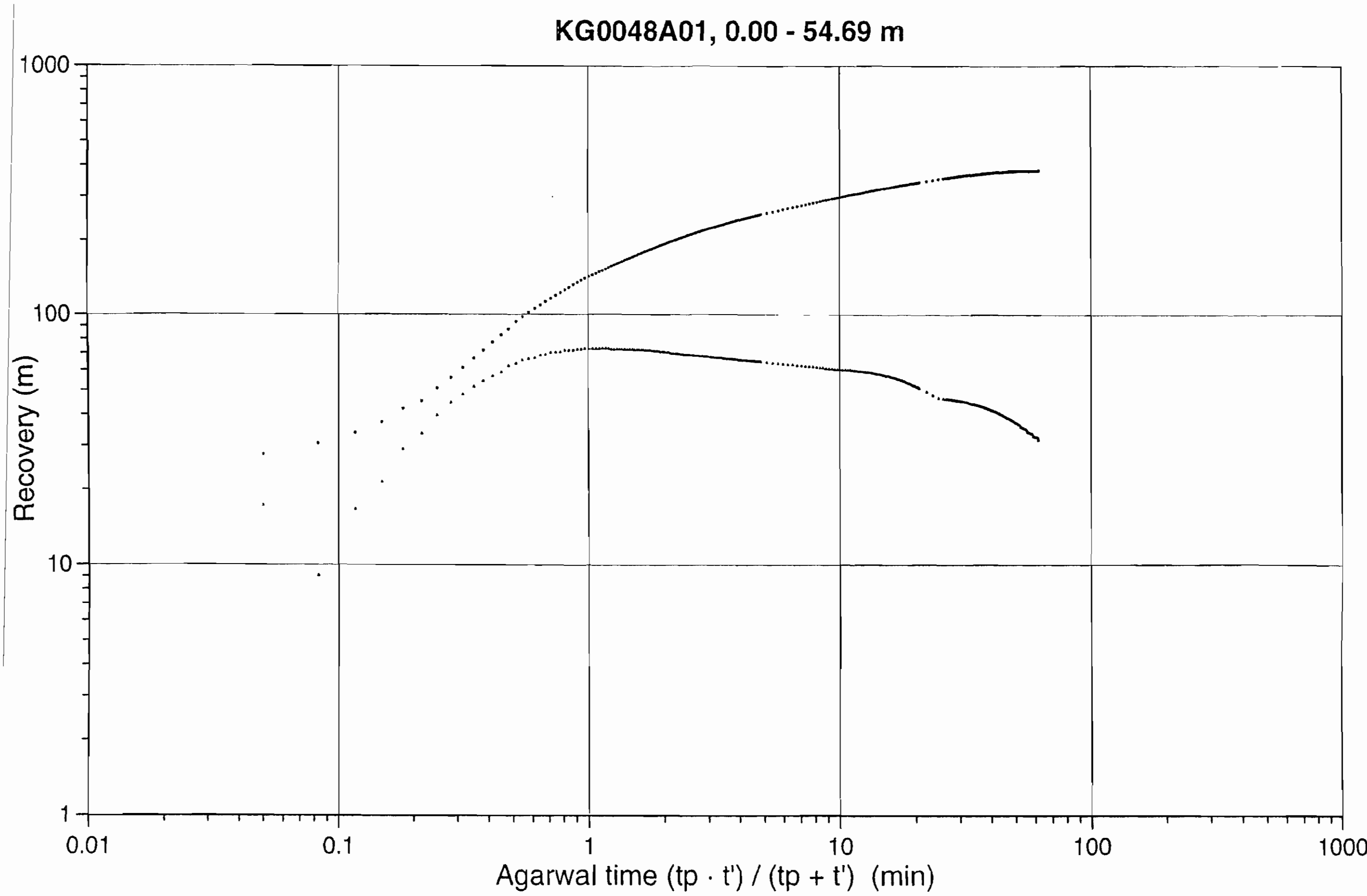




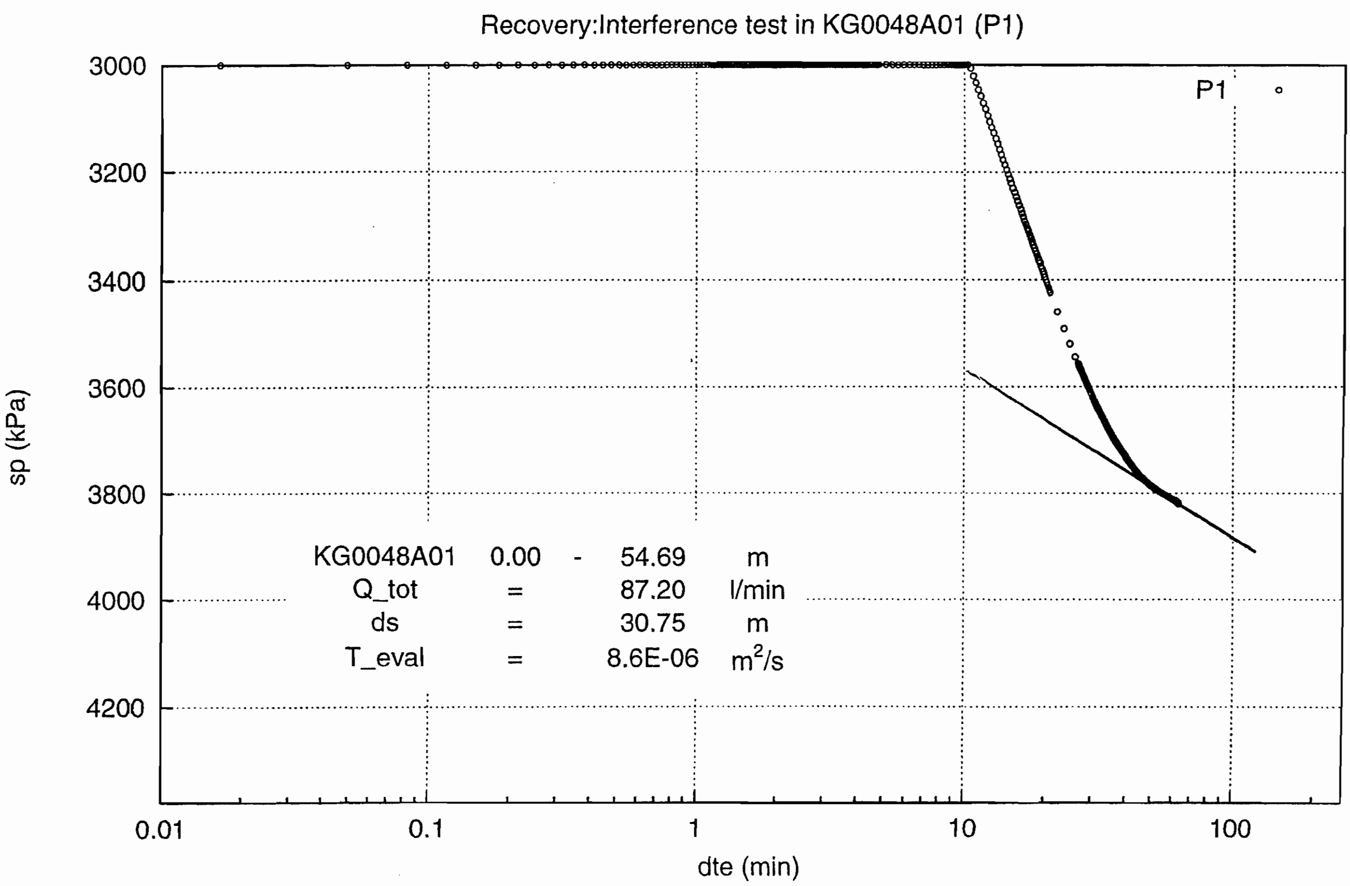
KG0021A01, 45.00 - 46.00 m
1000
100
10
1
0.1
Recovery (m)
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/44pb0021.grf 04/22/99



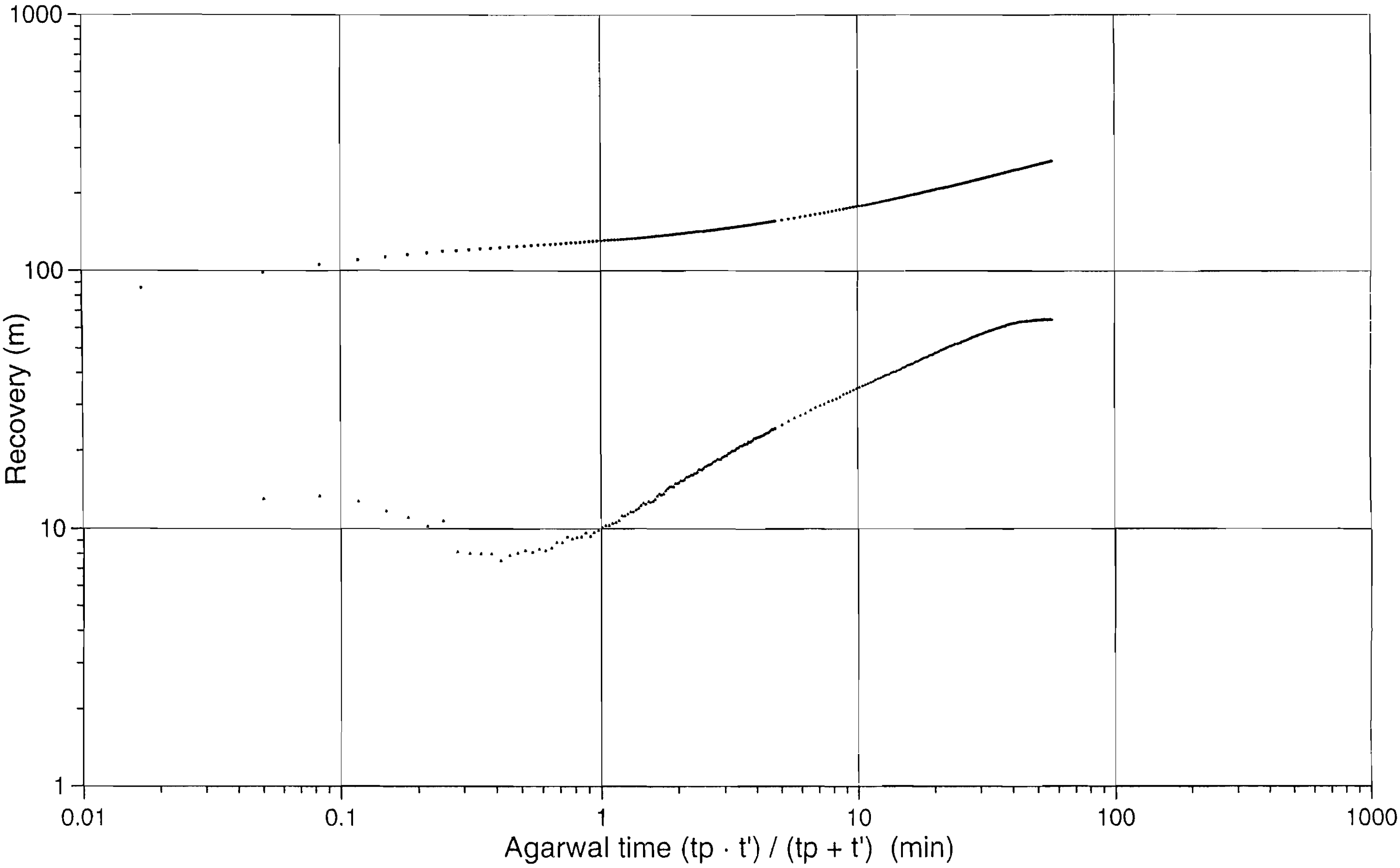
KG0021A01, 45.00 - 46.00 m
210
220
230
240
250
260
Recovery (m)
KG0021A01 45.00 - 46.00 m
Q_tot = 0.01 l/min
ds = - m
T_eval = - m²/s
0.001
0.01
0.1
1
10
100
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/44pl0021.grf 04/22/99



/13080198/DATA/bholeb03/ulv_03/3b/01pb0048.grl 04/22/99

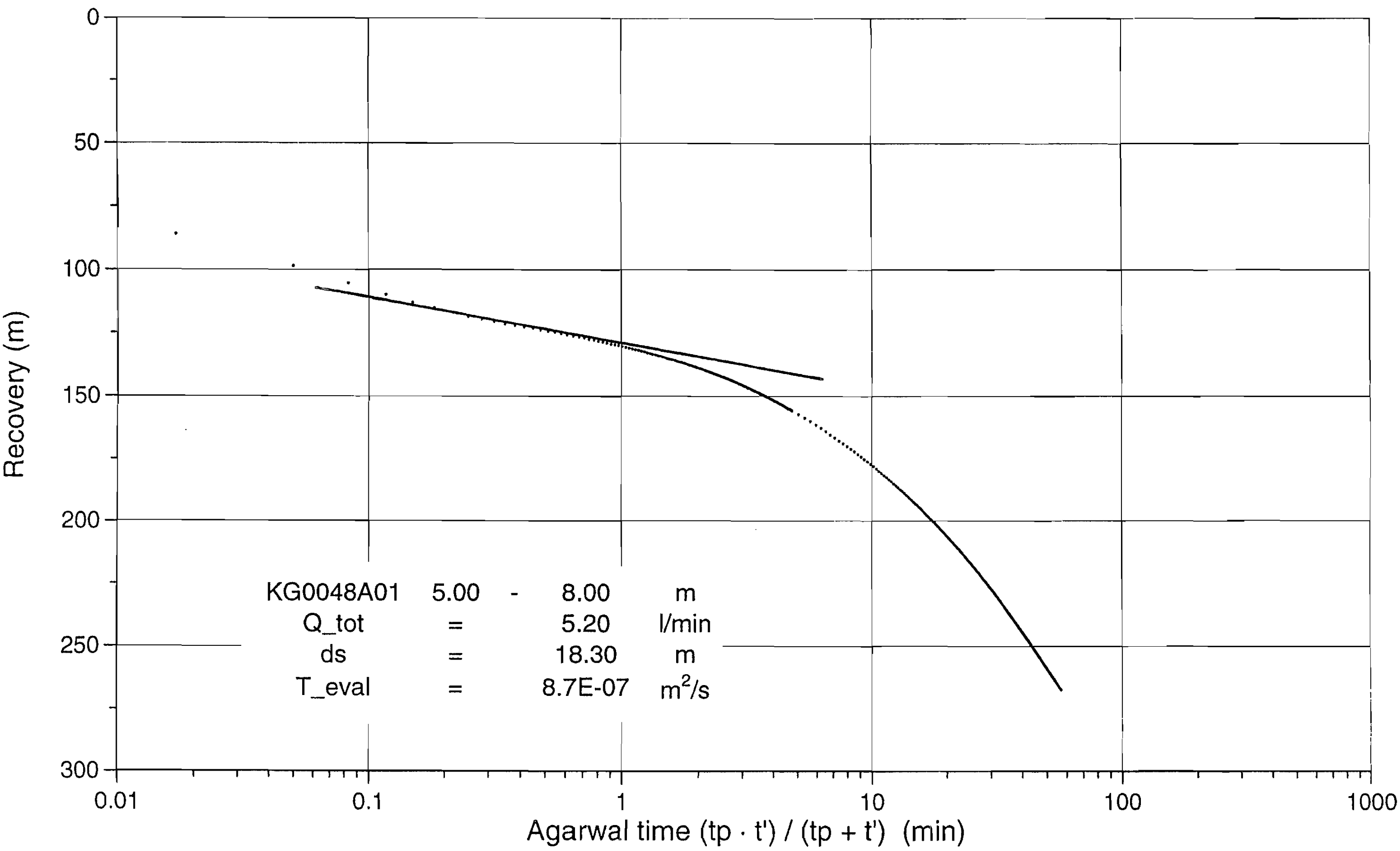


KG0048A01, 5.00 - 8.00 m

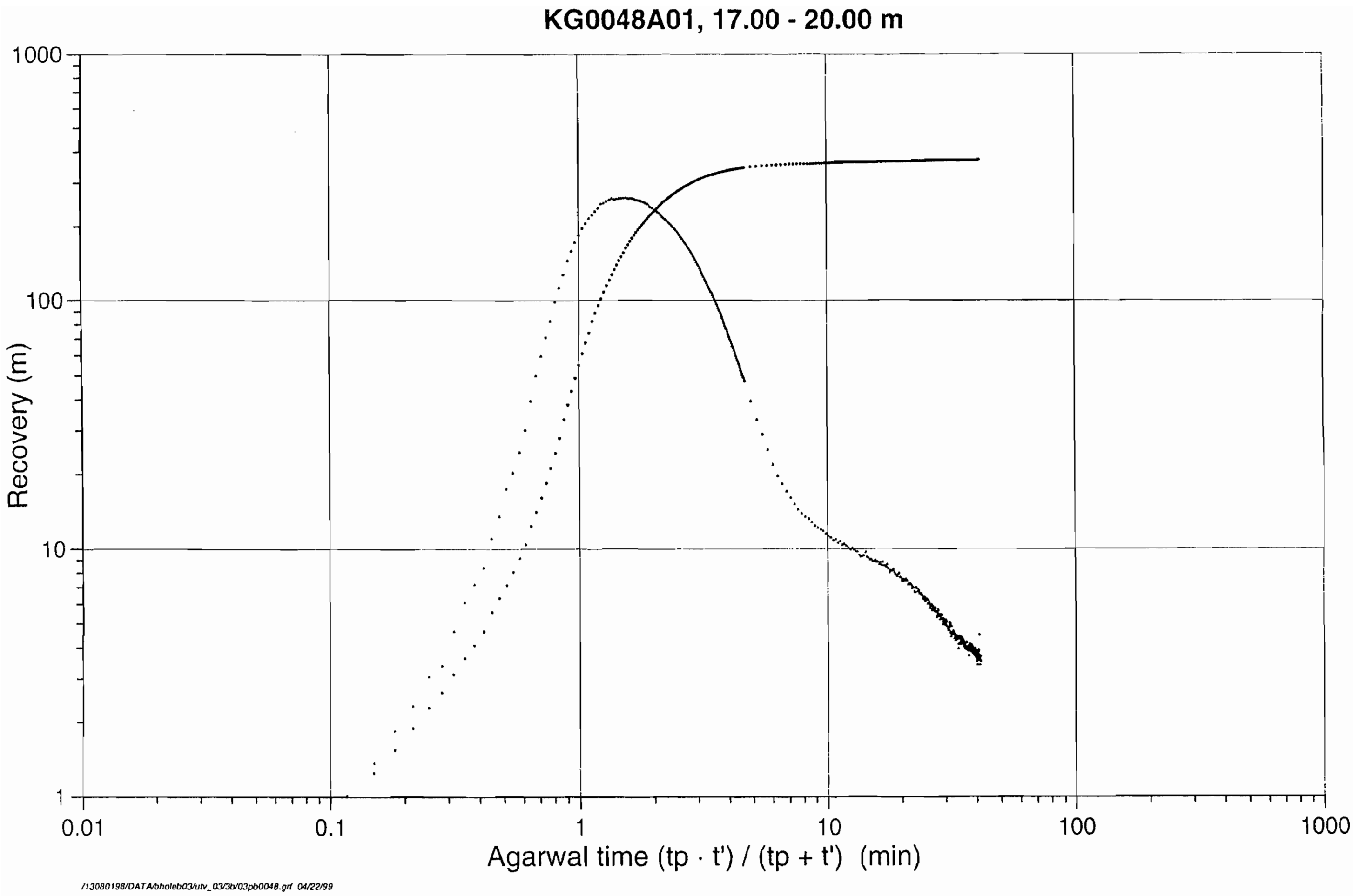


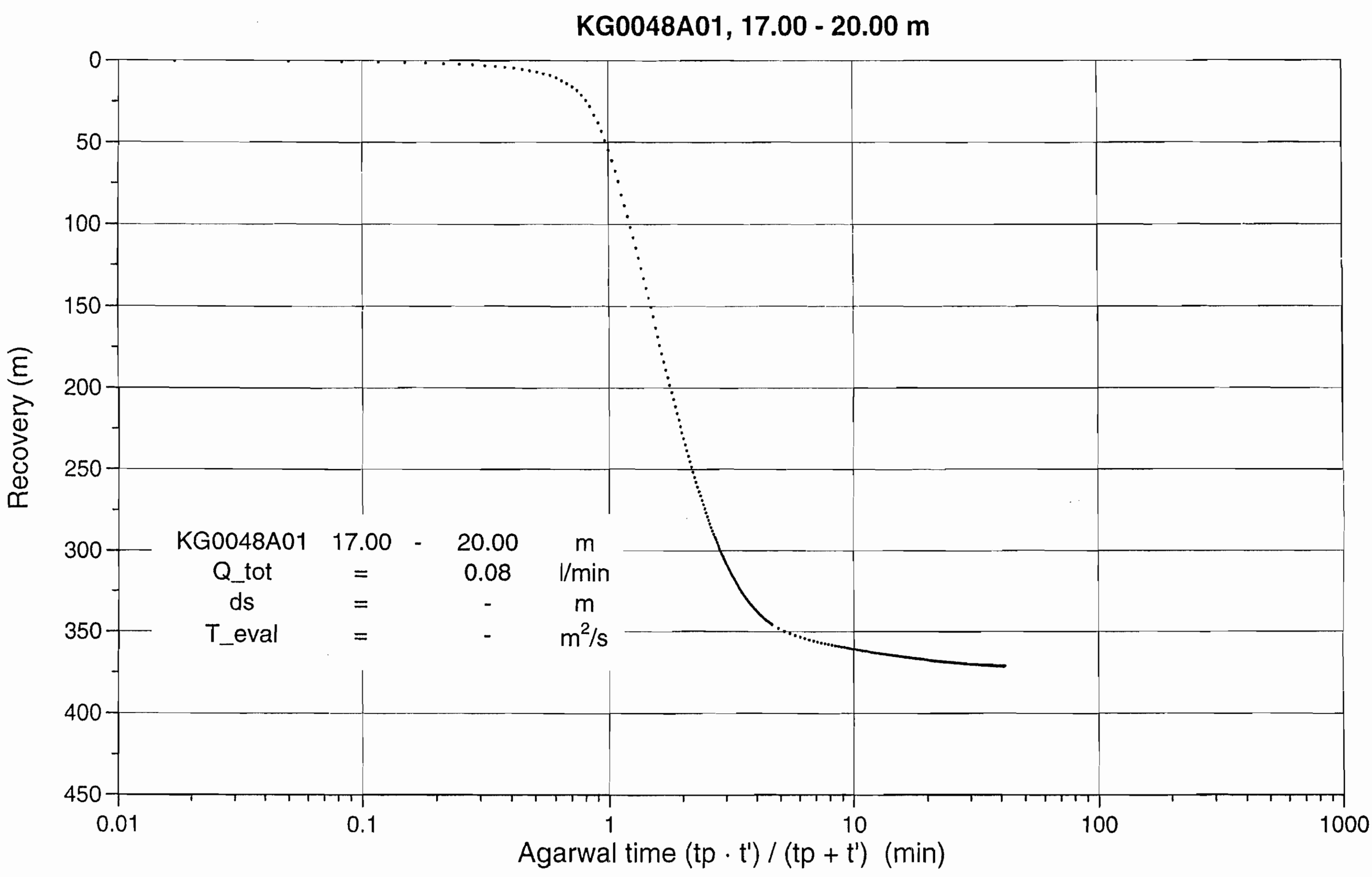
/13080198/DATA/bholeb03/utv_03/3b/02pb0048.grf 04/22/99

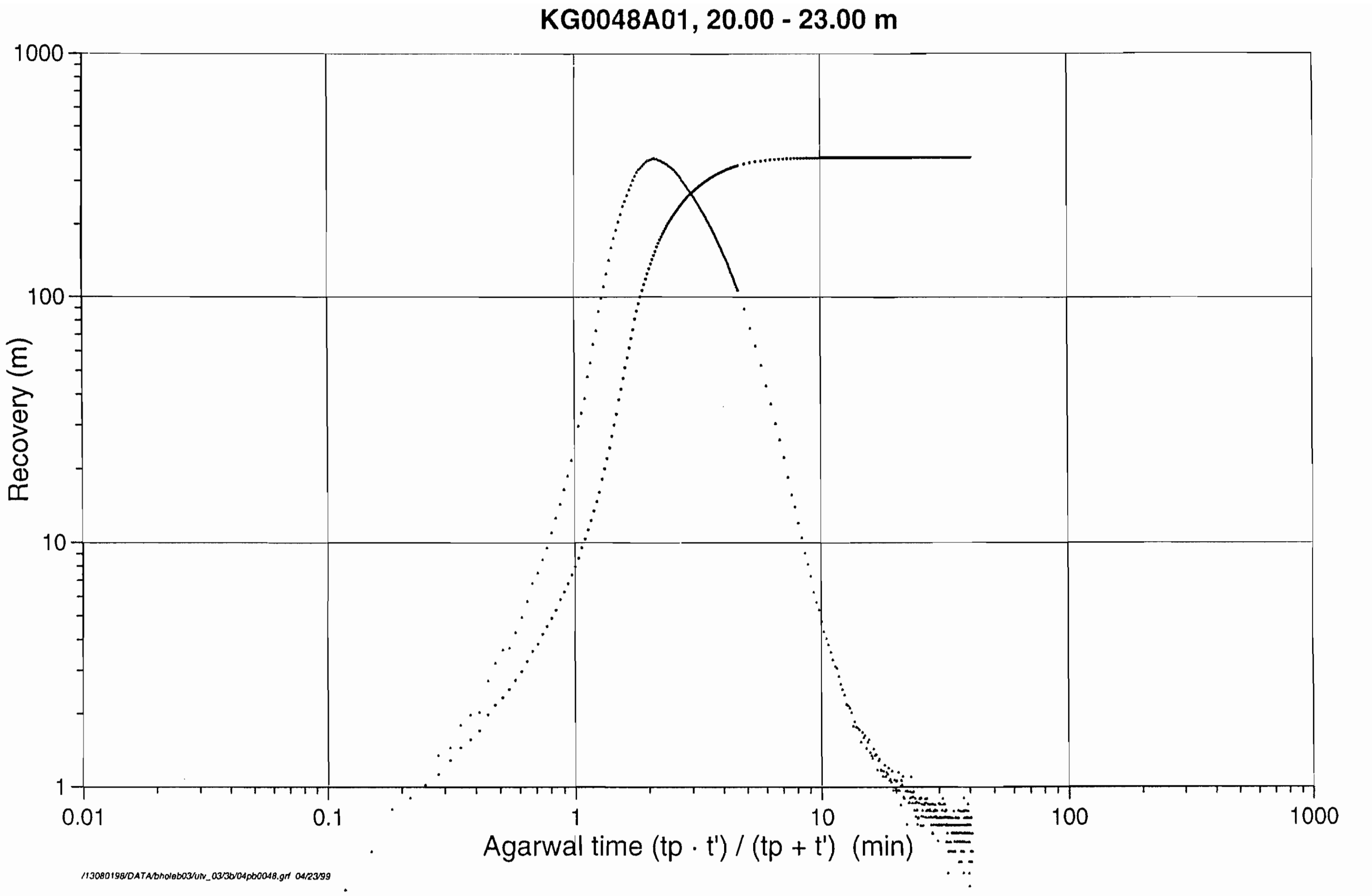
KG0048A01, 5.00 - 8.00 m



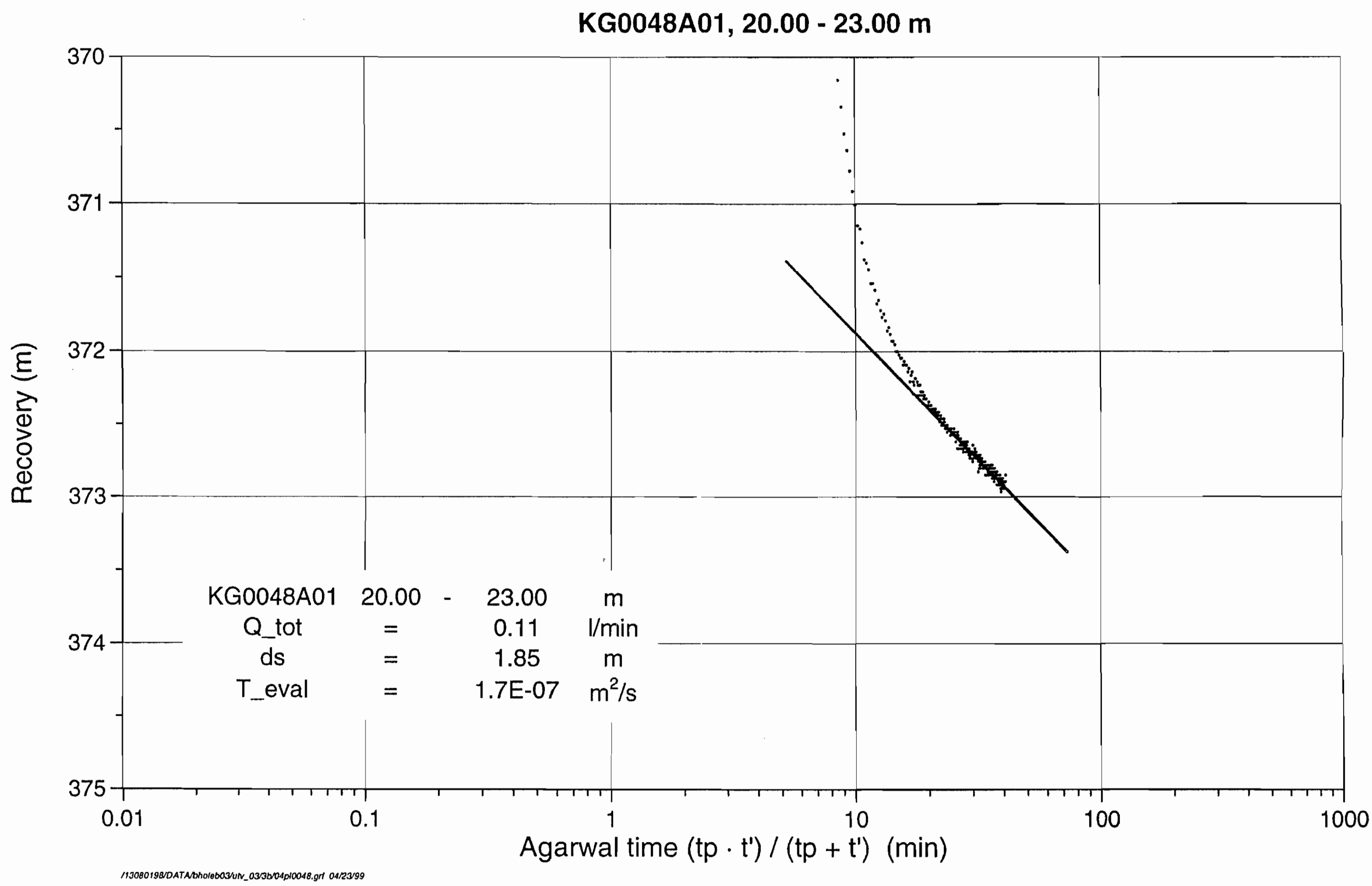
/13080198/DATA/bholeb03/utv_03/3b/02pb0048.grf 04/22/99


KG0048A01, 17.00 - 20.00 m
1000
100
10
1
Recovery (m)
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/03pb0048.grf 04/22/99

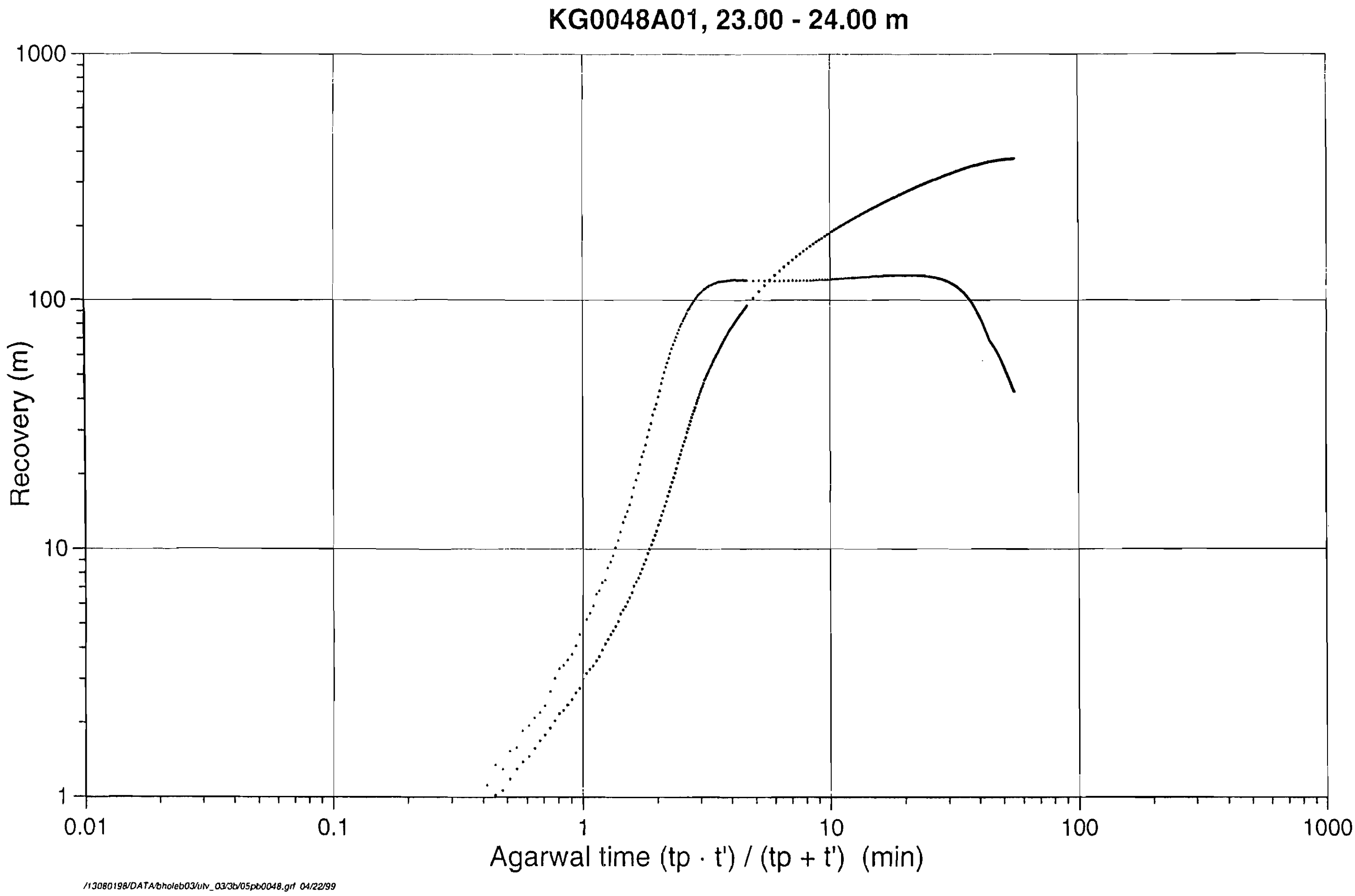

KG0048A01, 17.00 - 20.00 m
0
50
100
150
200
250
300
350
400
450
Recovery (m)
KG0048A01 17.00 - 20.00 m
Q_tot = 0.08 l/min
ds = - m
T_eval = - m²/s
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/03pl0048.grf 04/22/99

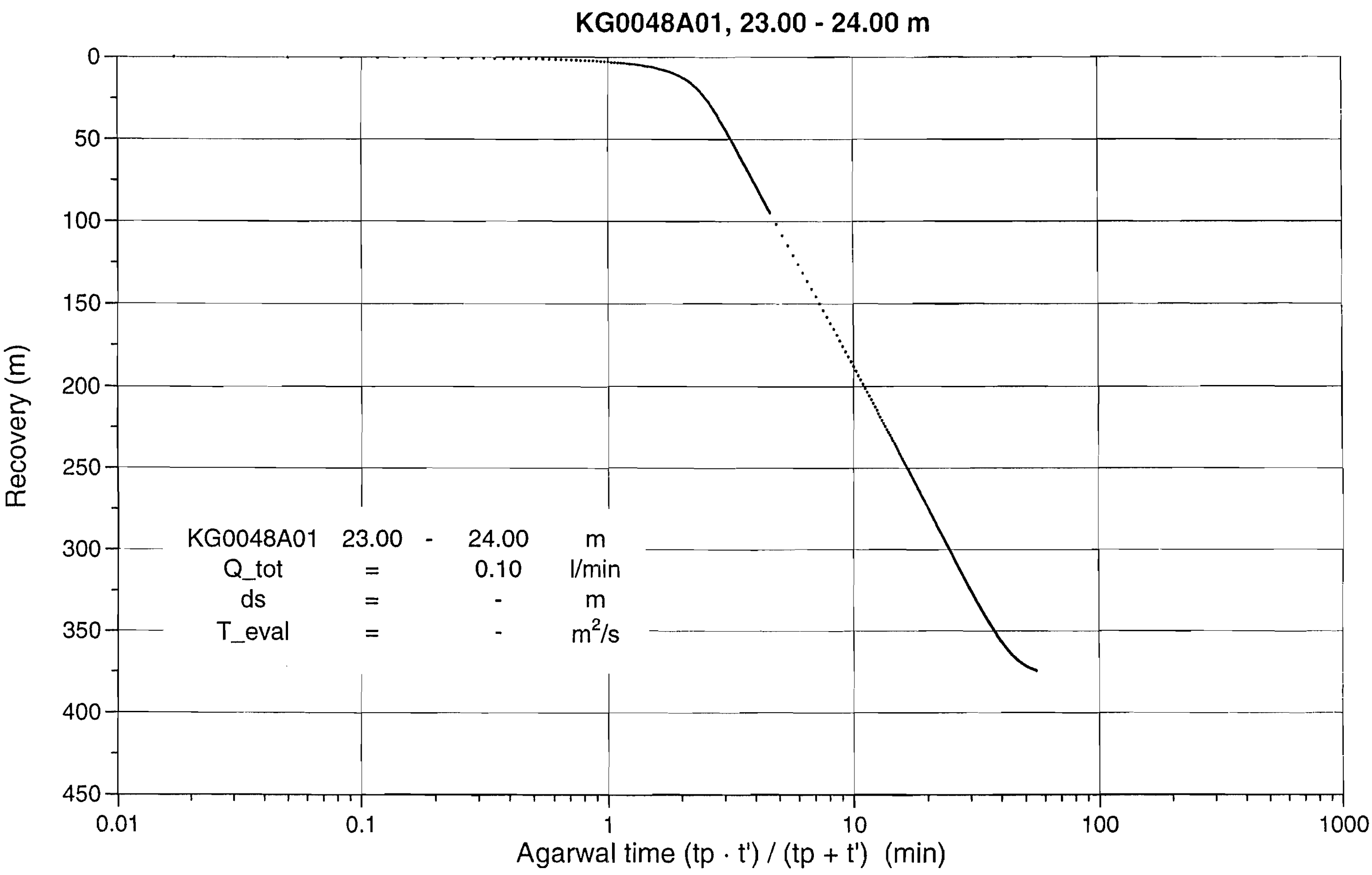


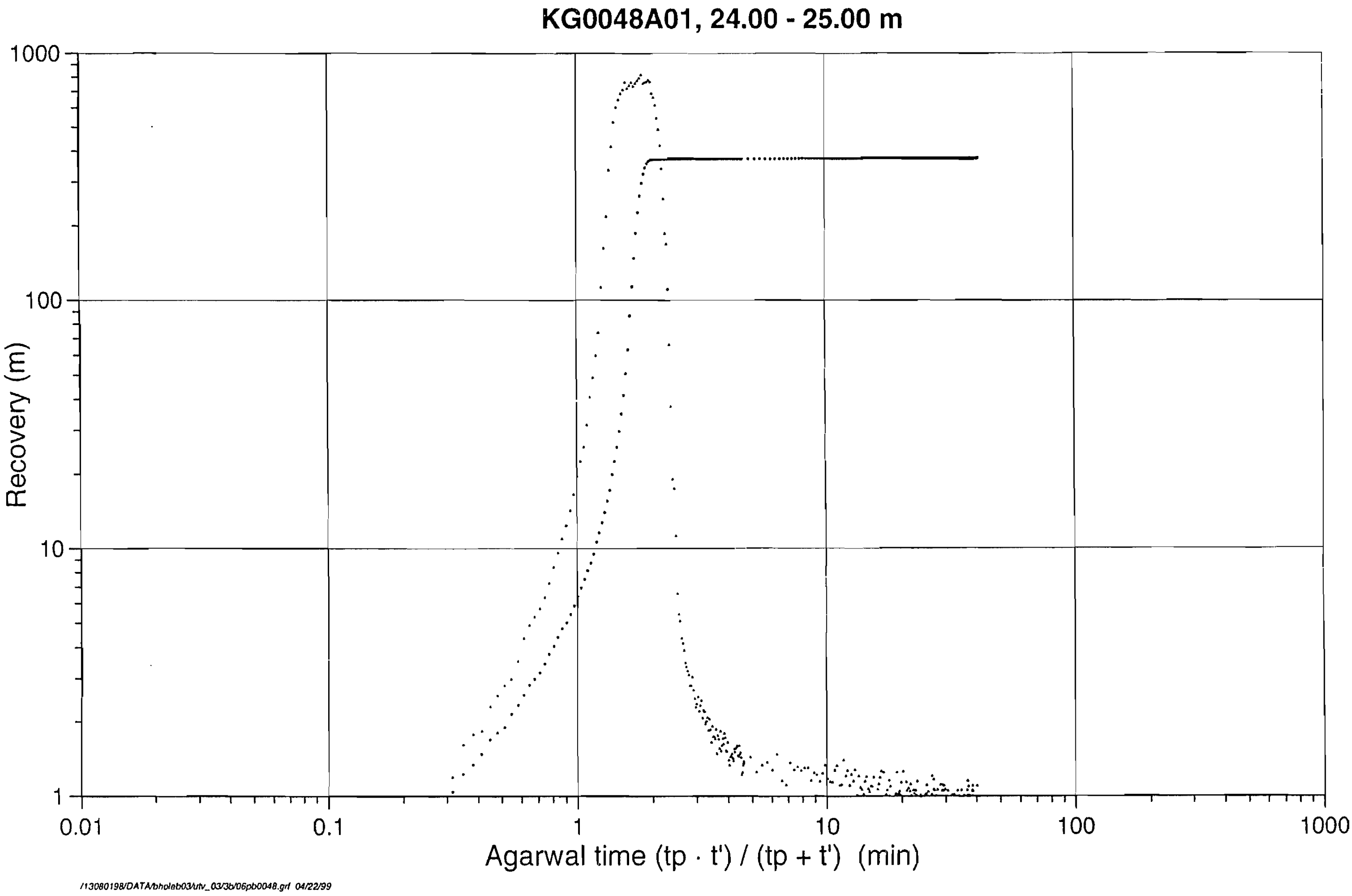
KG0048A01, 20.00 - 23.00 m
Recovery (m)
1000
100
10
1
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/04pb0048.grf 04/23/99

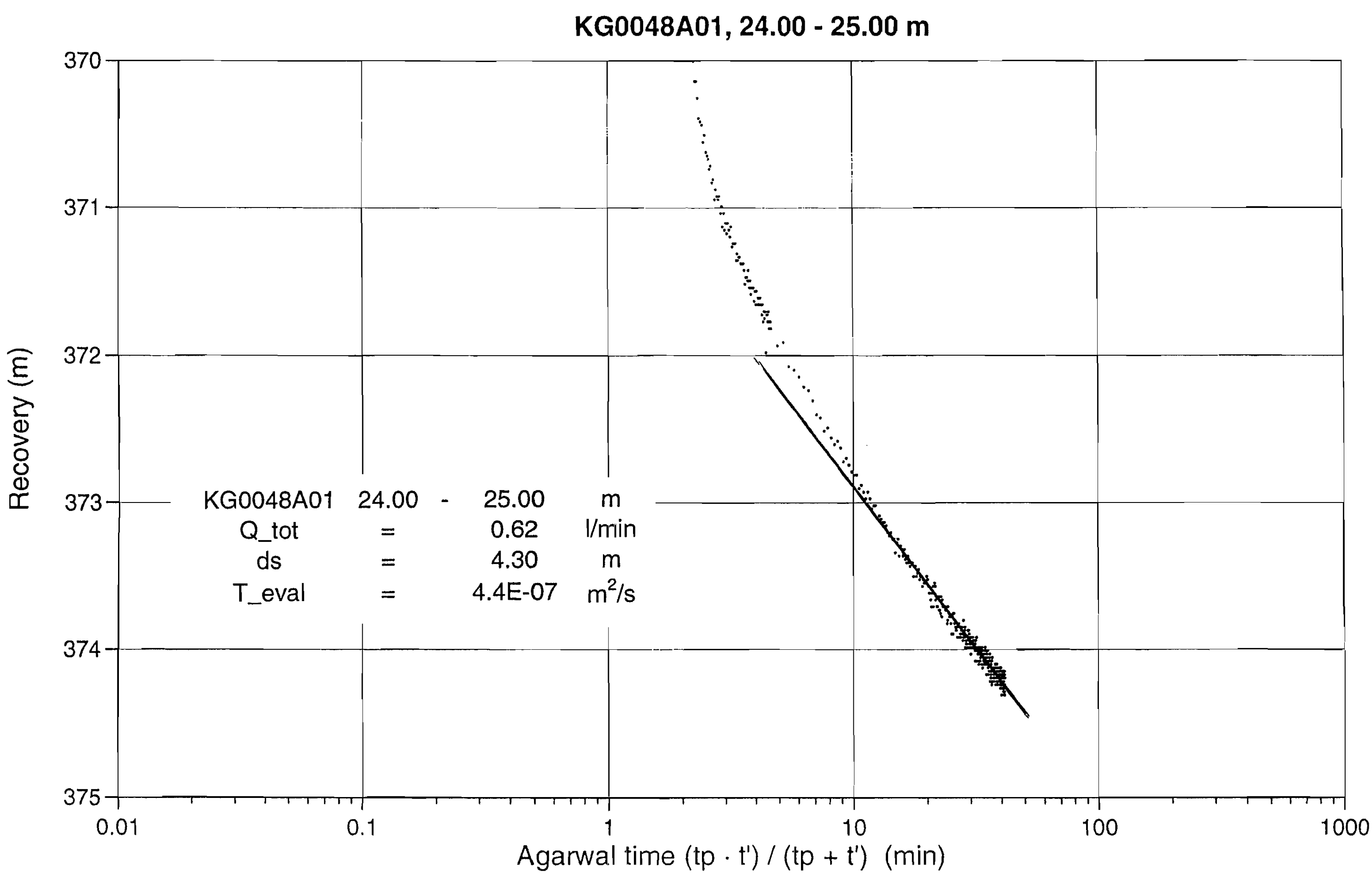


KG0048A01, 20.00 - 23.00 m
Recovery (m)
370
371
372
373
374
375
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
KG0048A01 20.00 - 23.00 m
Q_tot = 0.11 l/min
ds = 1.85 m
T_eval = 1.7E-07 m²/s
/13080198/DATA/bholeb03/utv_03/3b/04pl0048.grf 04/23/99

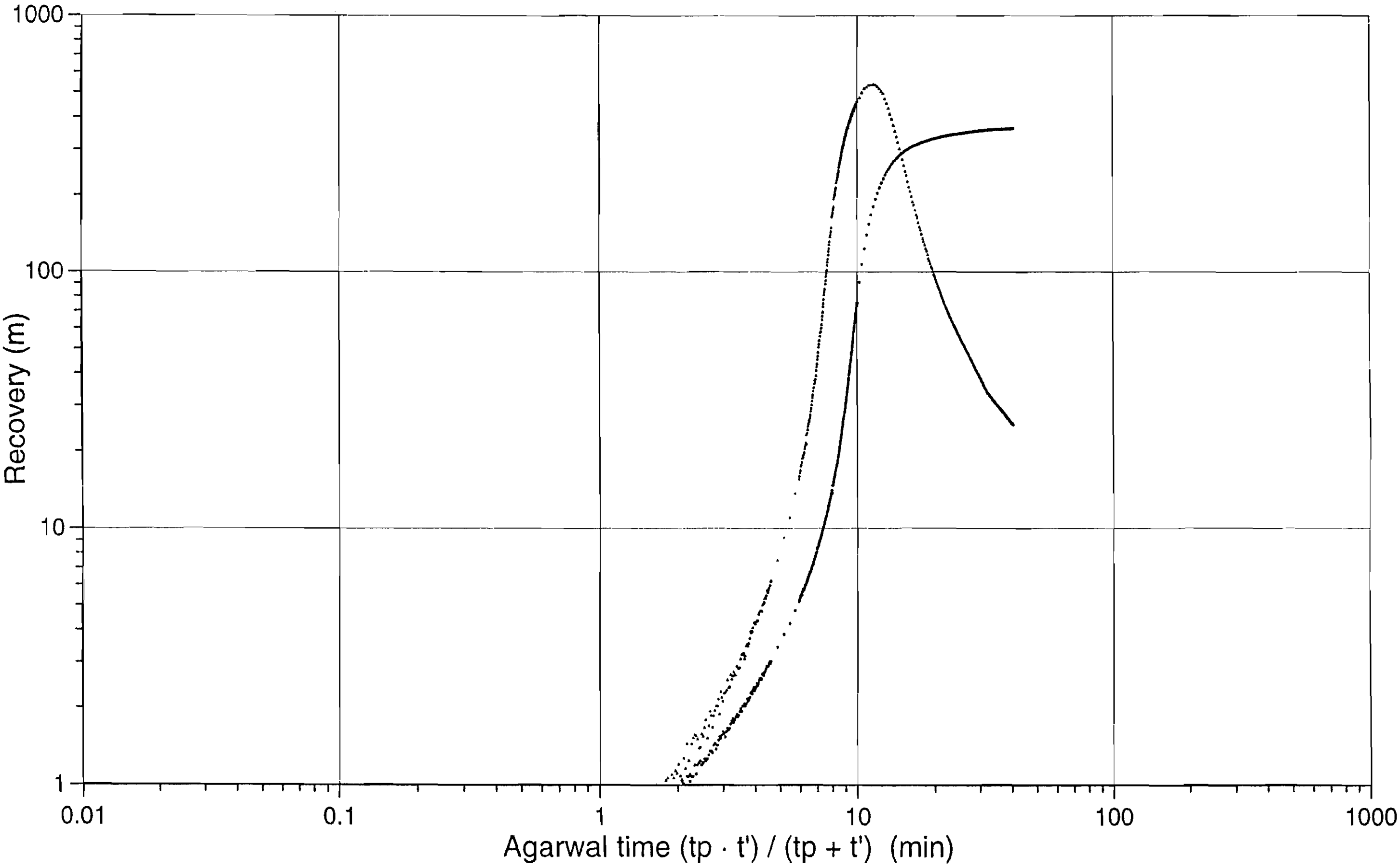

KG0048A01, 23.00 - 24.00 m
1000
100
10
1
Recovery (m)
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/05pb0048.grf 04/22/99


KG0048A01, 23.00 - 24.00 m
0
50
100
150
200
250
300
350
400
450
Recovery (m)
KG0048A01 23.00 - 24.00 m
Q_tot = 0.10 l/min
ds = - m
T_eval = - m²/s
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/05pl0048.grf 04/22/99


KG0048A01, 24.00 - 25.00 m
Recovery (m)
1000
100
10
1
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/06pb0048.grf 04/22/99

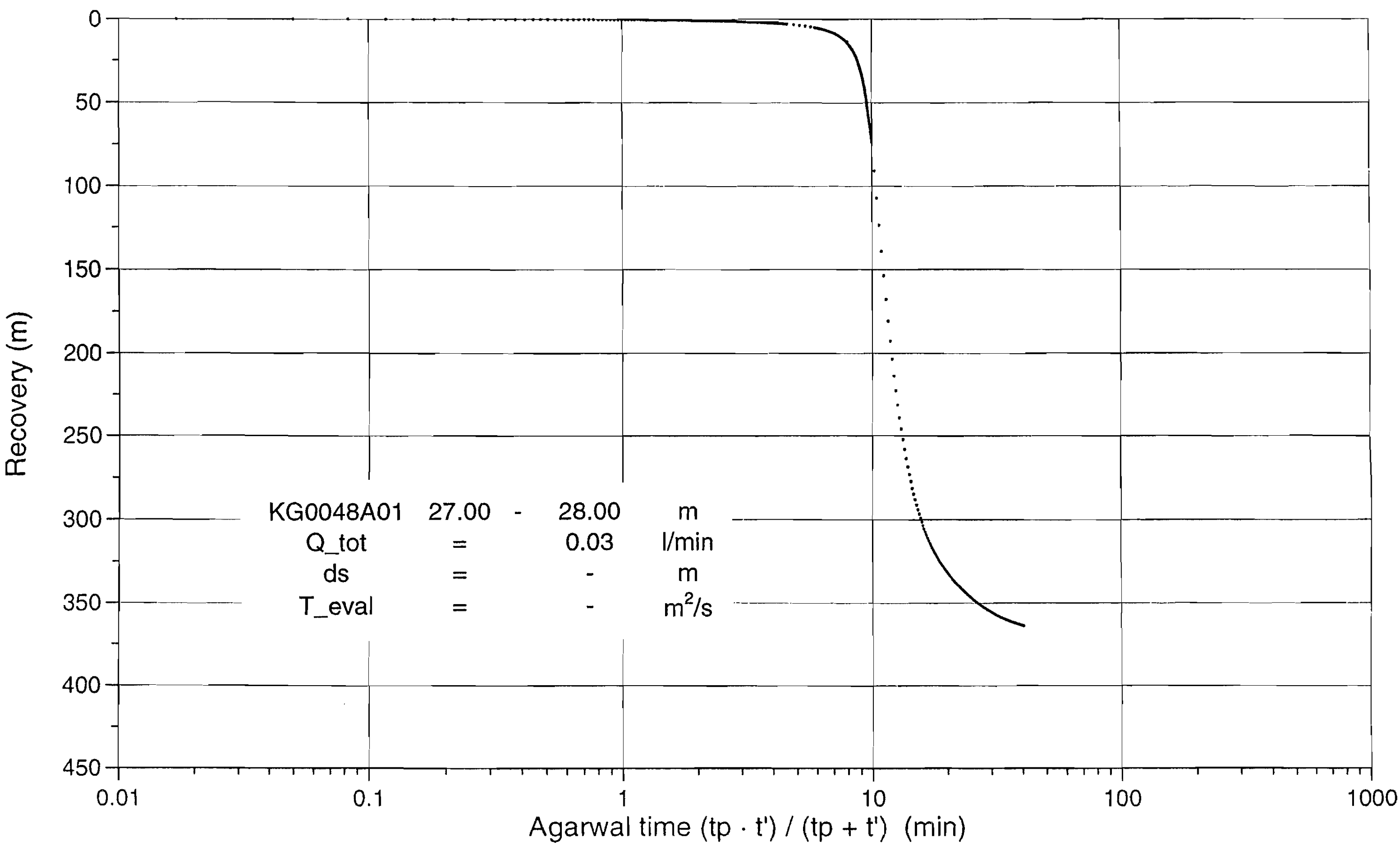

KG0048A01, 24.00 - 25.00 m
Recovery (m)
370
371
372
373
374
375
KG0048A01 24.00 - 25.00 m
Q_tot = 0.62 l/min
ds = 4.30 m
T_eval = 4.4E-07 m2/s
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/06pl0048.grf 04/22/99

KG0048A01, 27.00 - 28.00 m



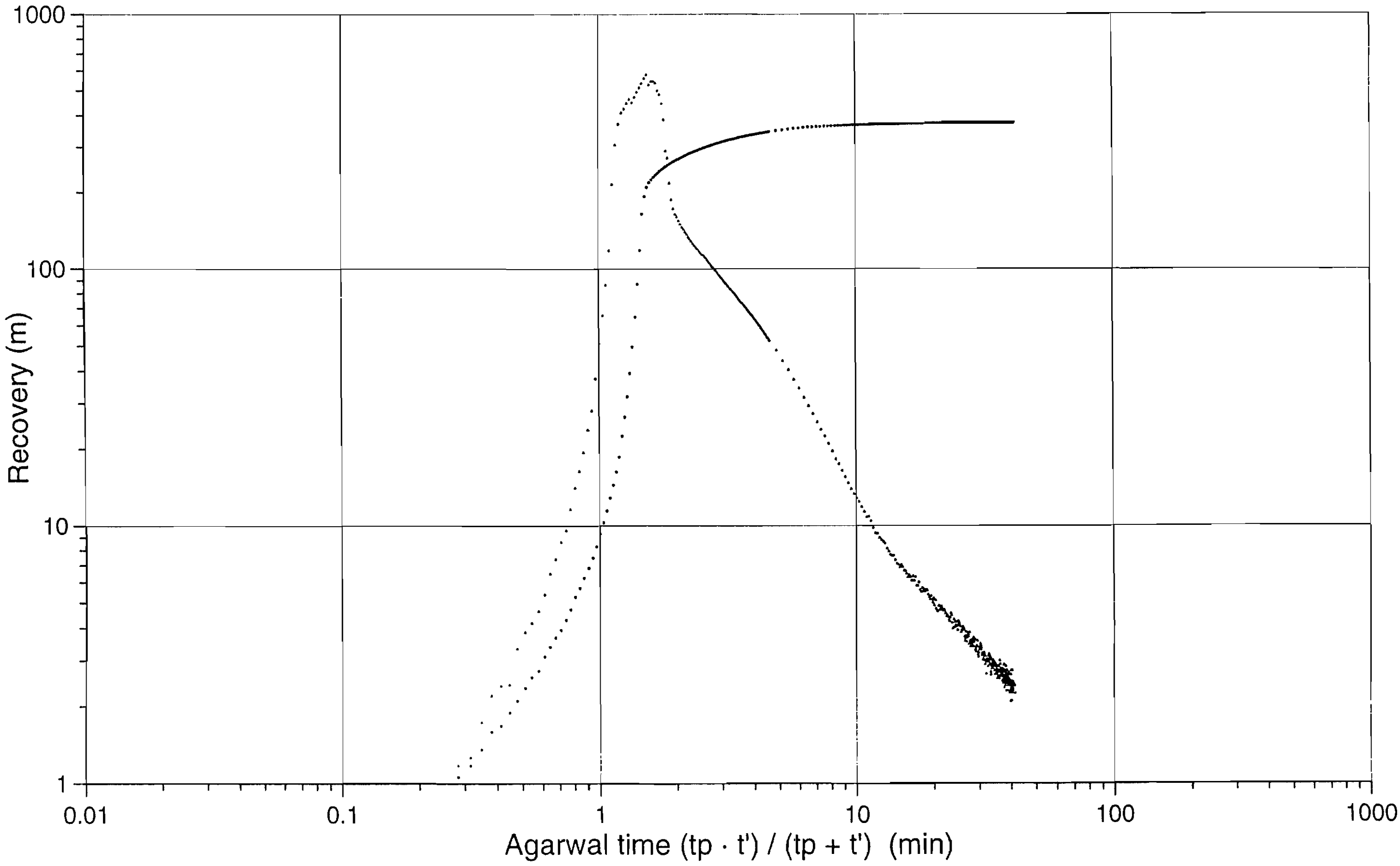
/13080198/DATA/bholeb03/utv_03/3b/07pb0048.grf 04/22/99

KG0048A01, 27.00 - 28.00 m



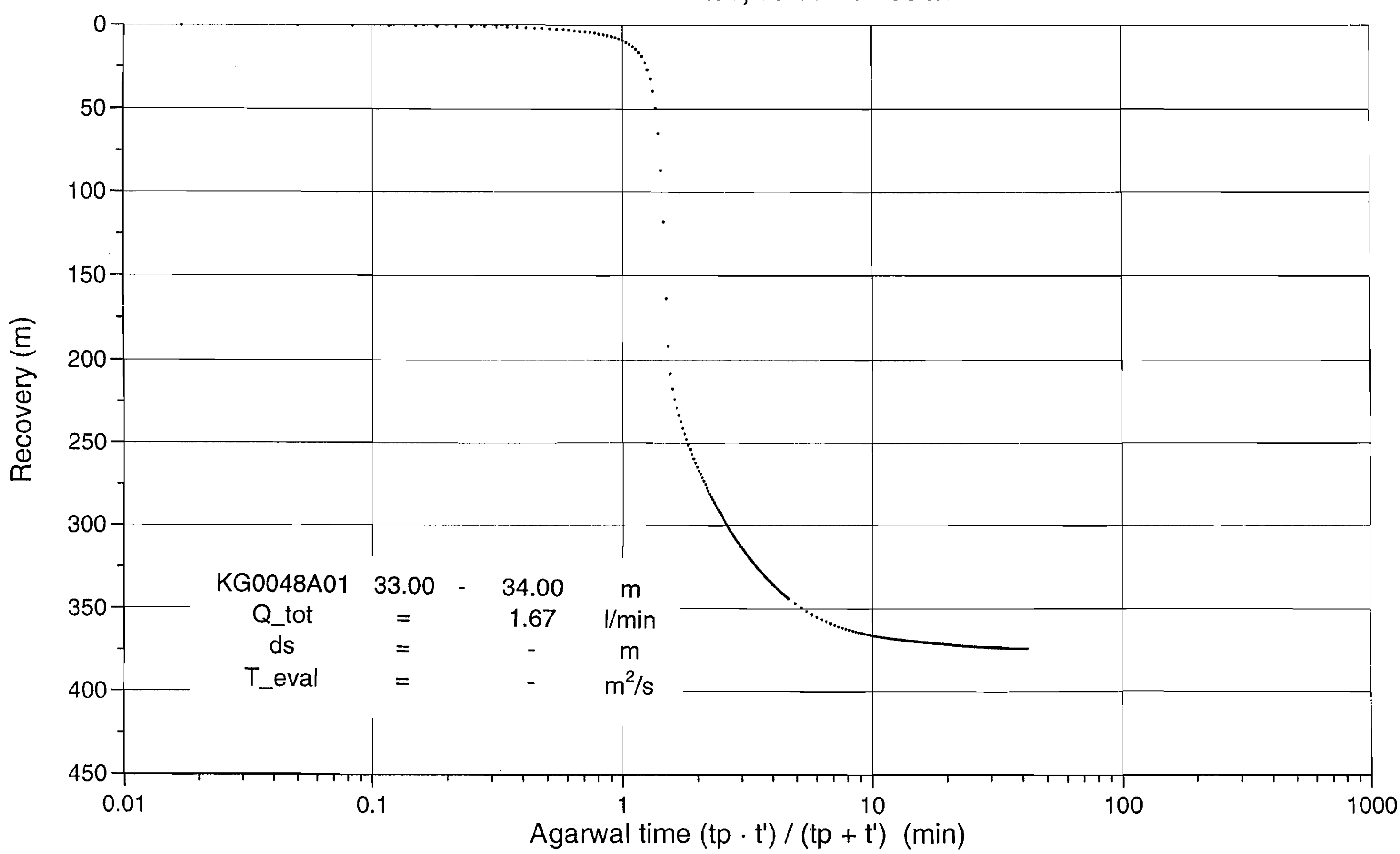
/13080198/DATA/bholeb03/utv_03/3b/07pl0048.grf 04/22/99

KG0048A01, 33.00 - 34.00 m

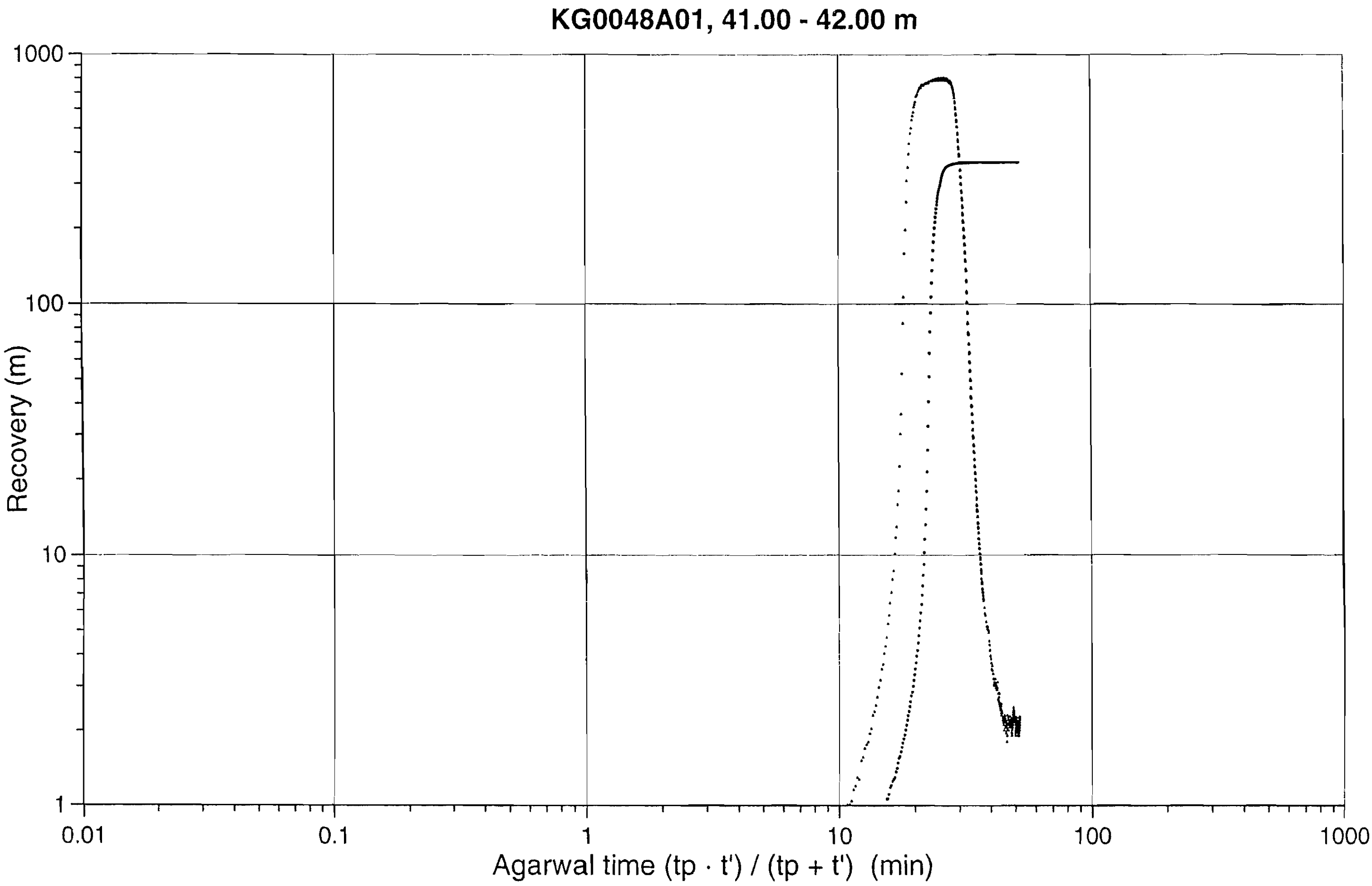


/13080198/DATA/bholeb03/utv_03/3b/08pb0048.grf 04/22/99

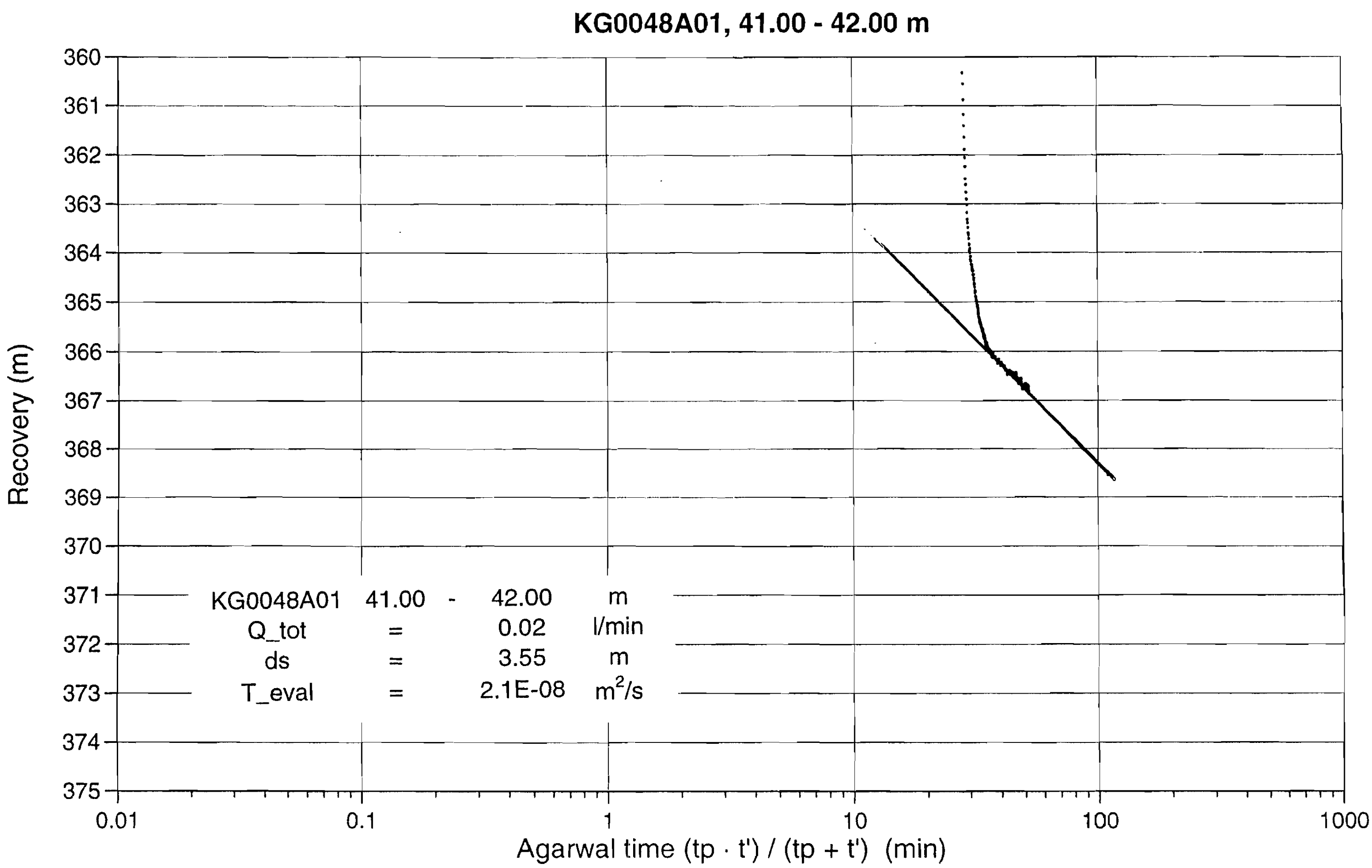
KG0048A01, 33.00 - 34.00 m



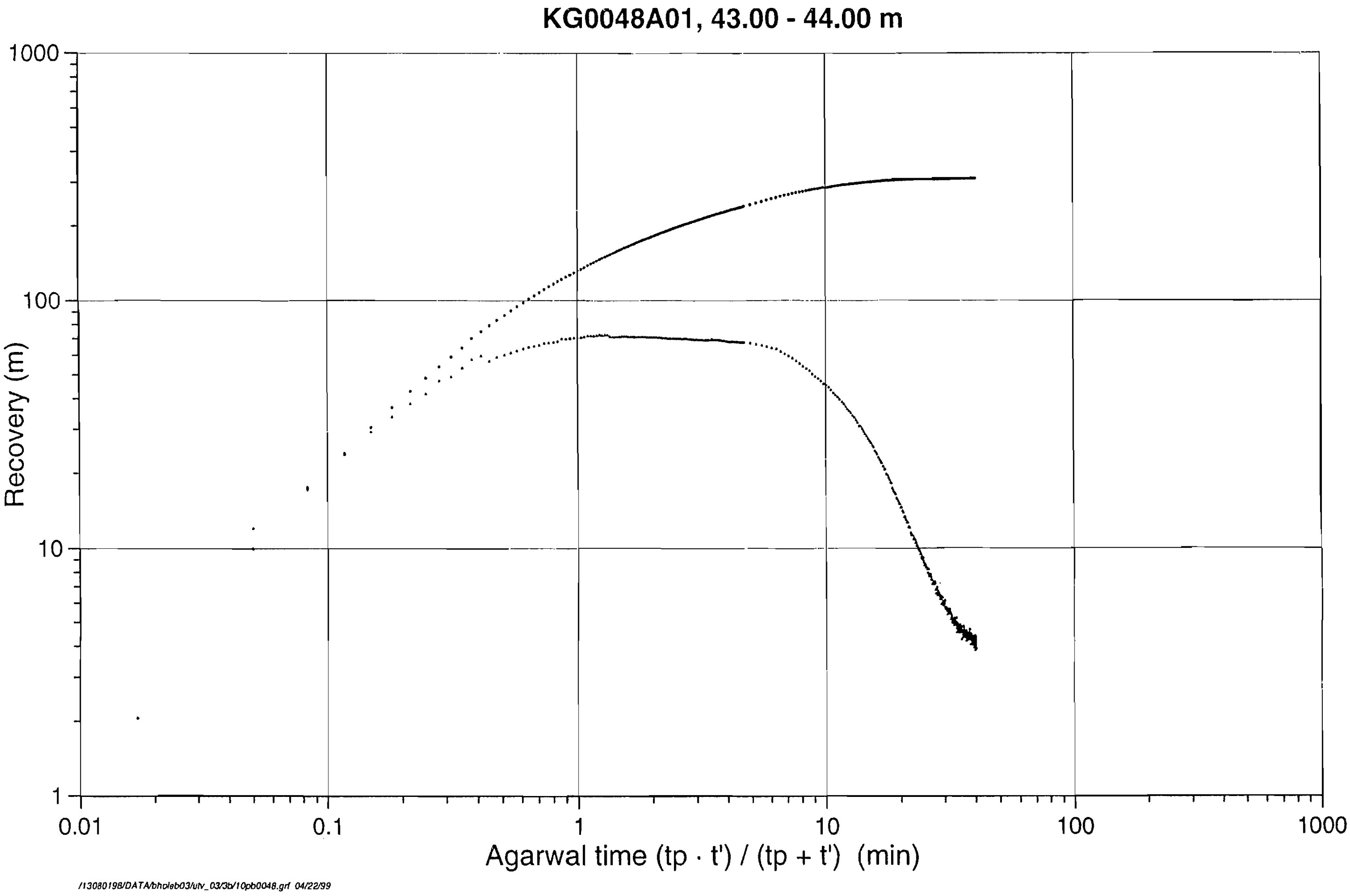
/13080198/DATA/bholeb03/utv_03/3b/08pl0048.grf 04/22/99



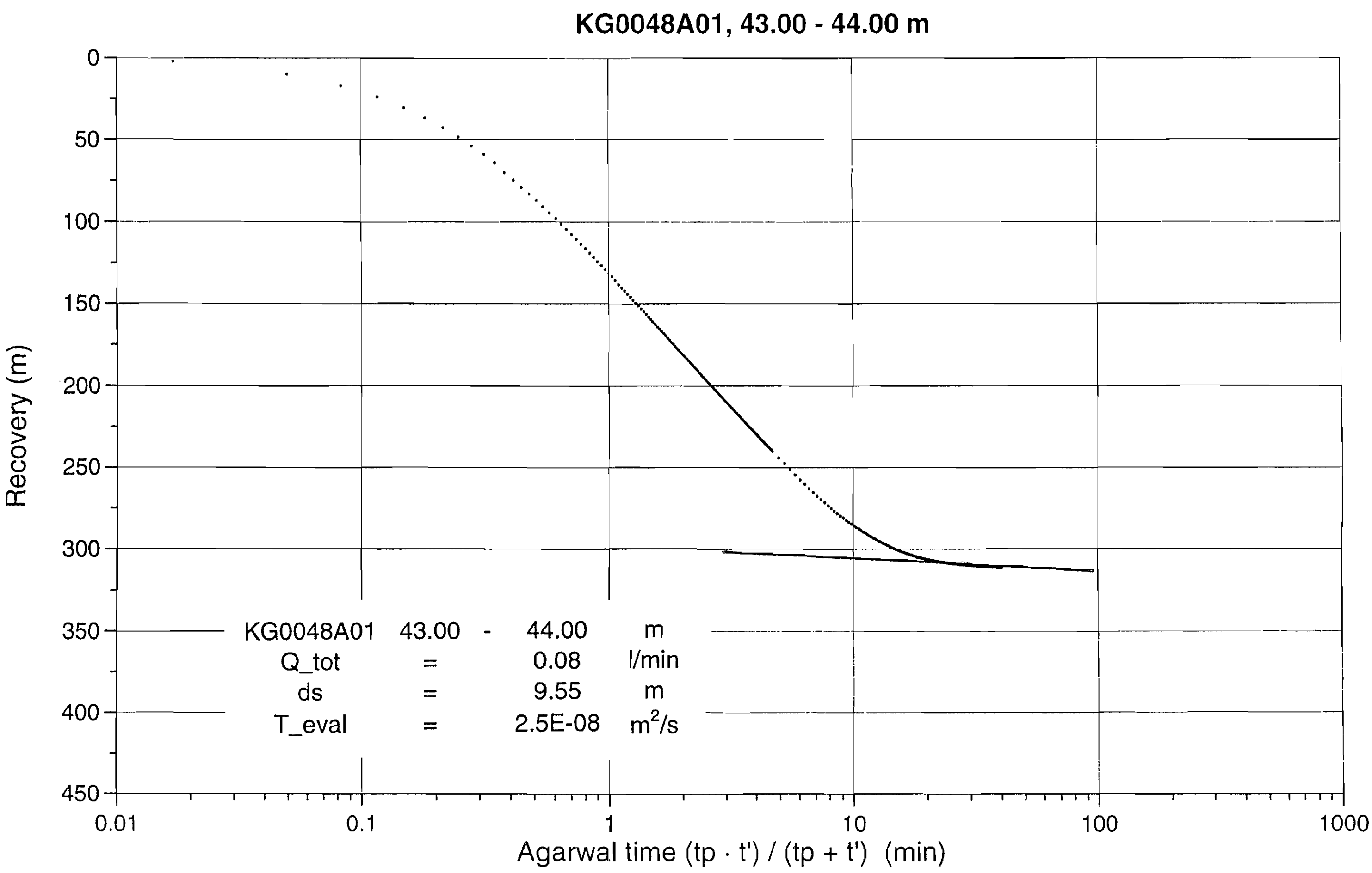
/13080198/DATA/bholab03/utv_03/3b/09pb0048.grf 04/22/99



/13080198/DATA/bholab03/utv_03/3b/09pl0048.grf 04/22/99

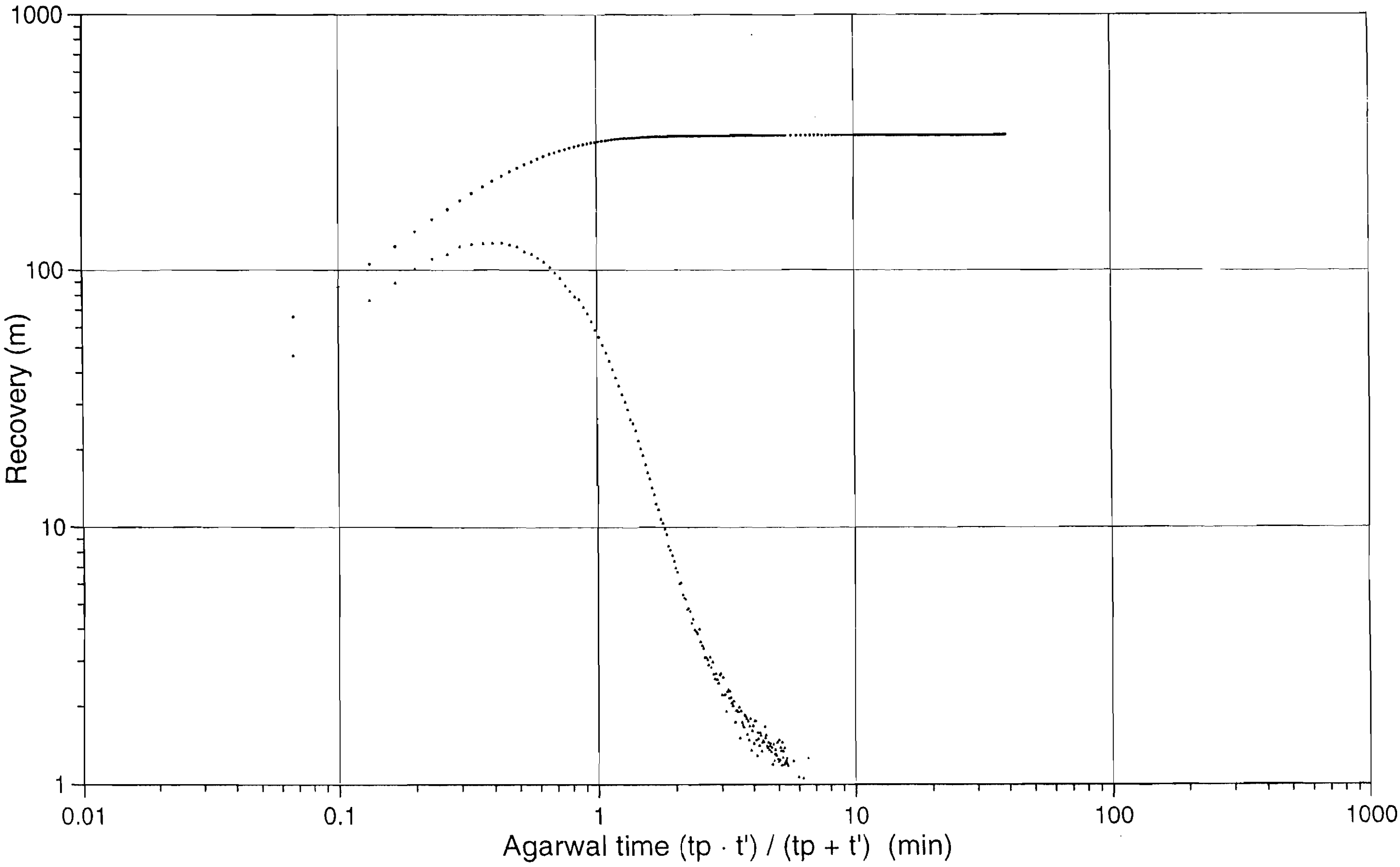


KG0048A01, 43.00 - 44.00 m
Recovery (m)
1000
100
10
1
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/10pb0048.grf 04/22/99



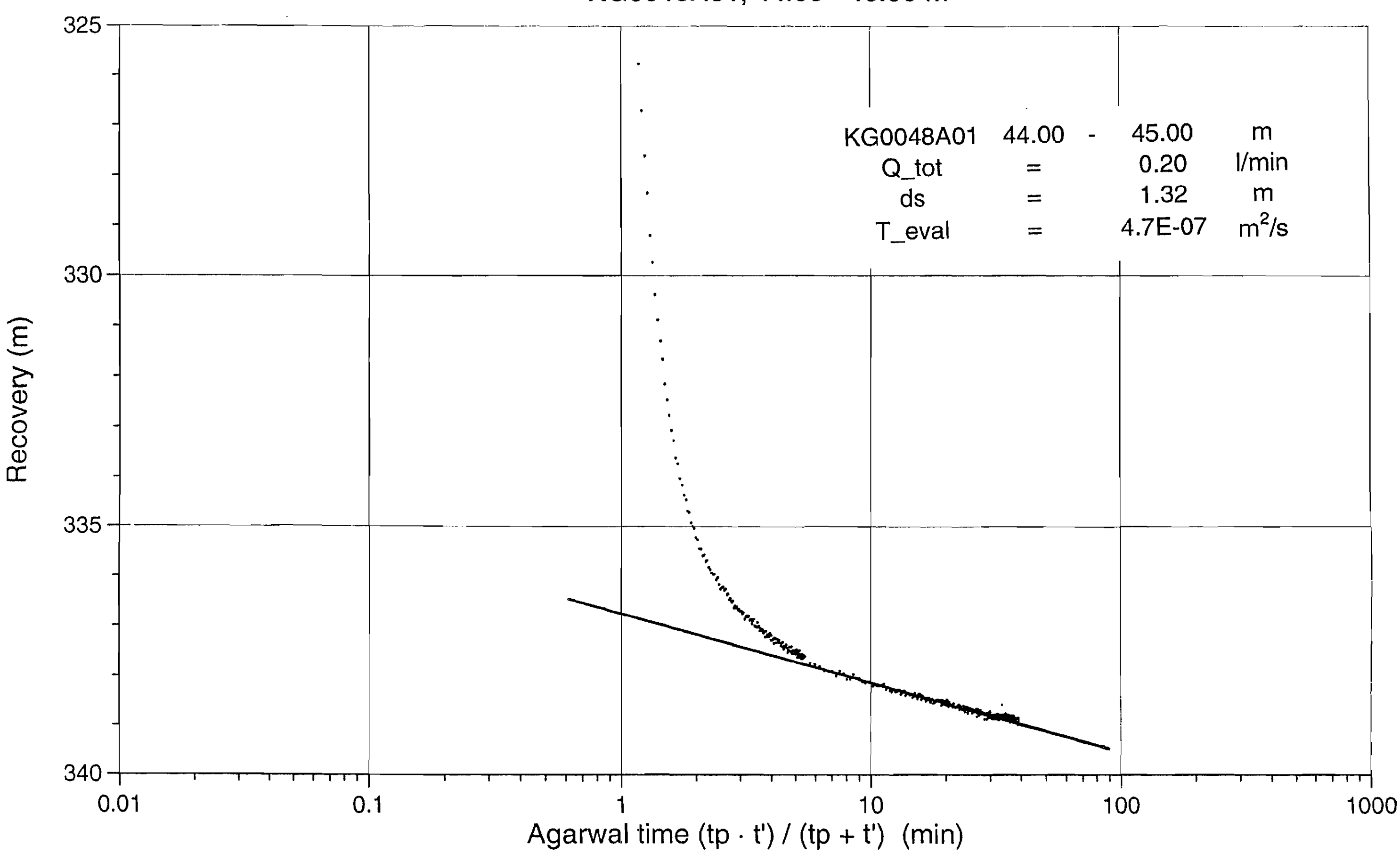
KG0048A01, 43.00 - 44.00 m
Recovery (m)
0
50
100
150
200
250
300
350
400
450
KG0048A01 43.00 - 44.00 m
Q_tot = 0.08 l/min
ds = 9.55 m
T_eval = 2.5E-08 m2/s
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/10pl0048.grf 04/22/99

KG0048A01, 44.00 - 45.00 m

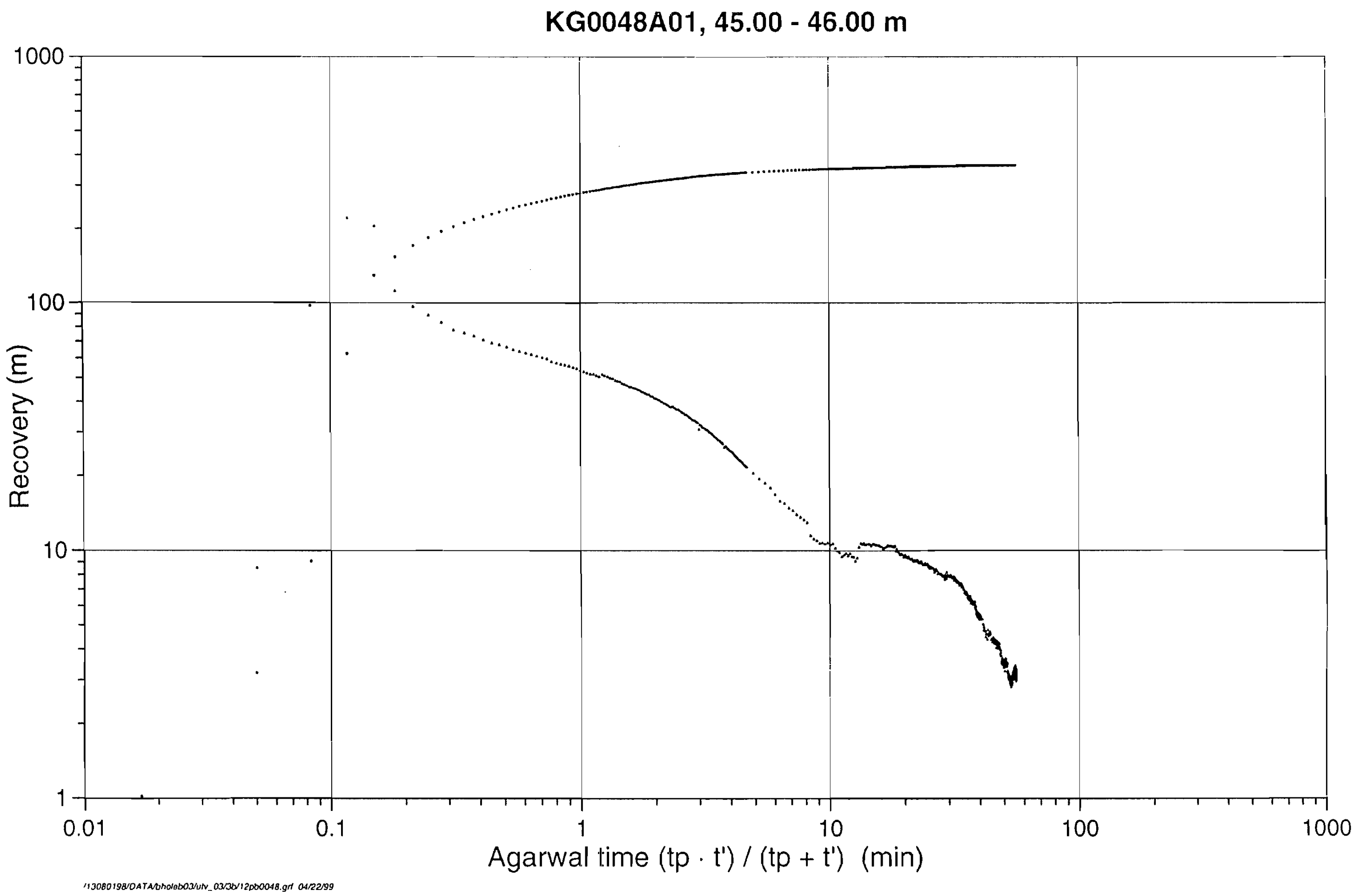


/13080198/DATA/bholeb03/utv_03/3b/11pb0048.grf 04/22/99

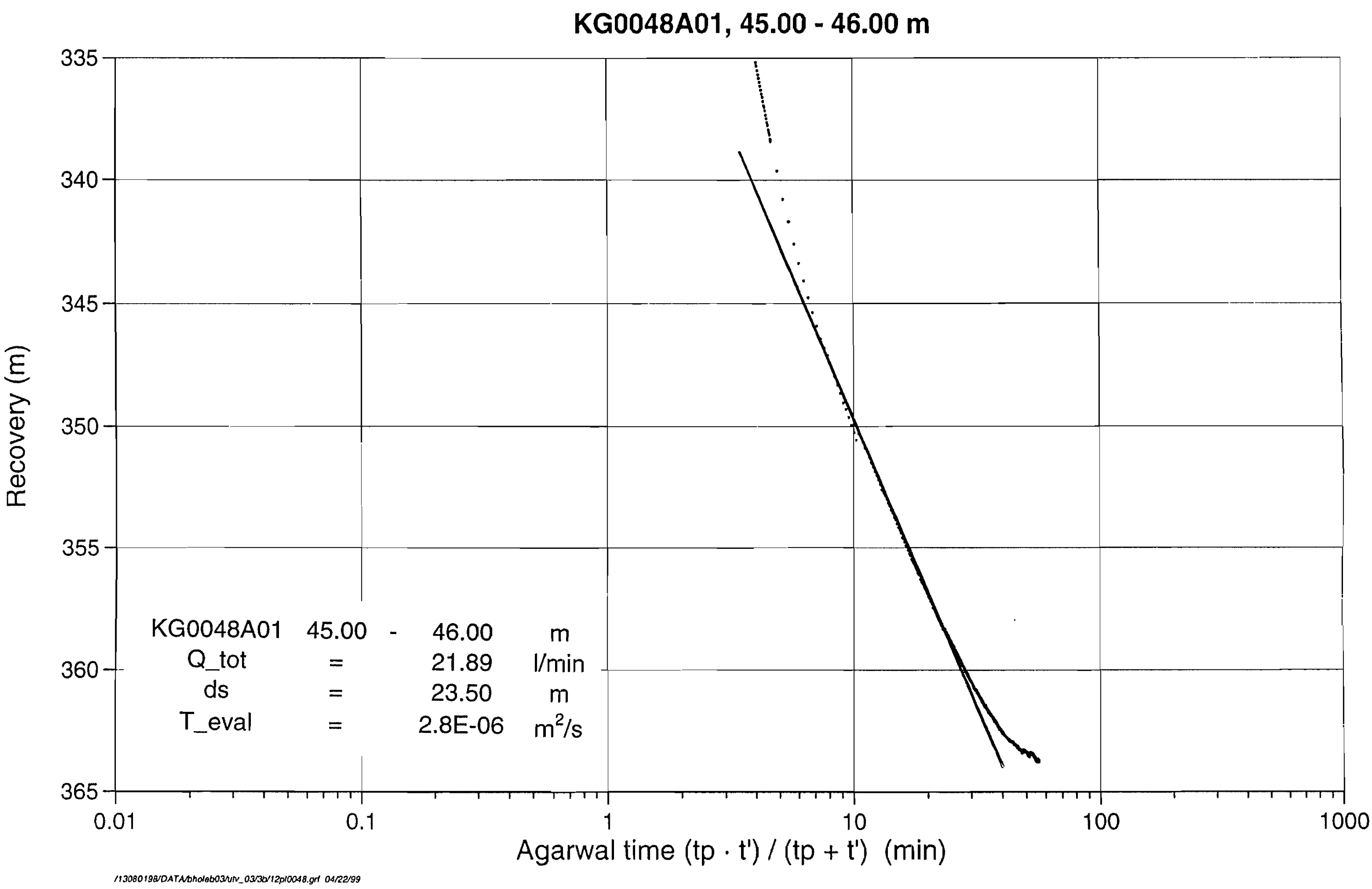
KG0048A01, 44.00 - 45.00 m



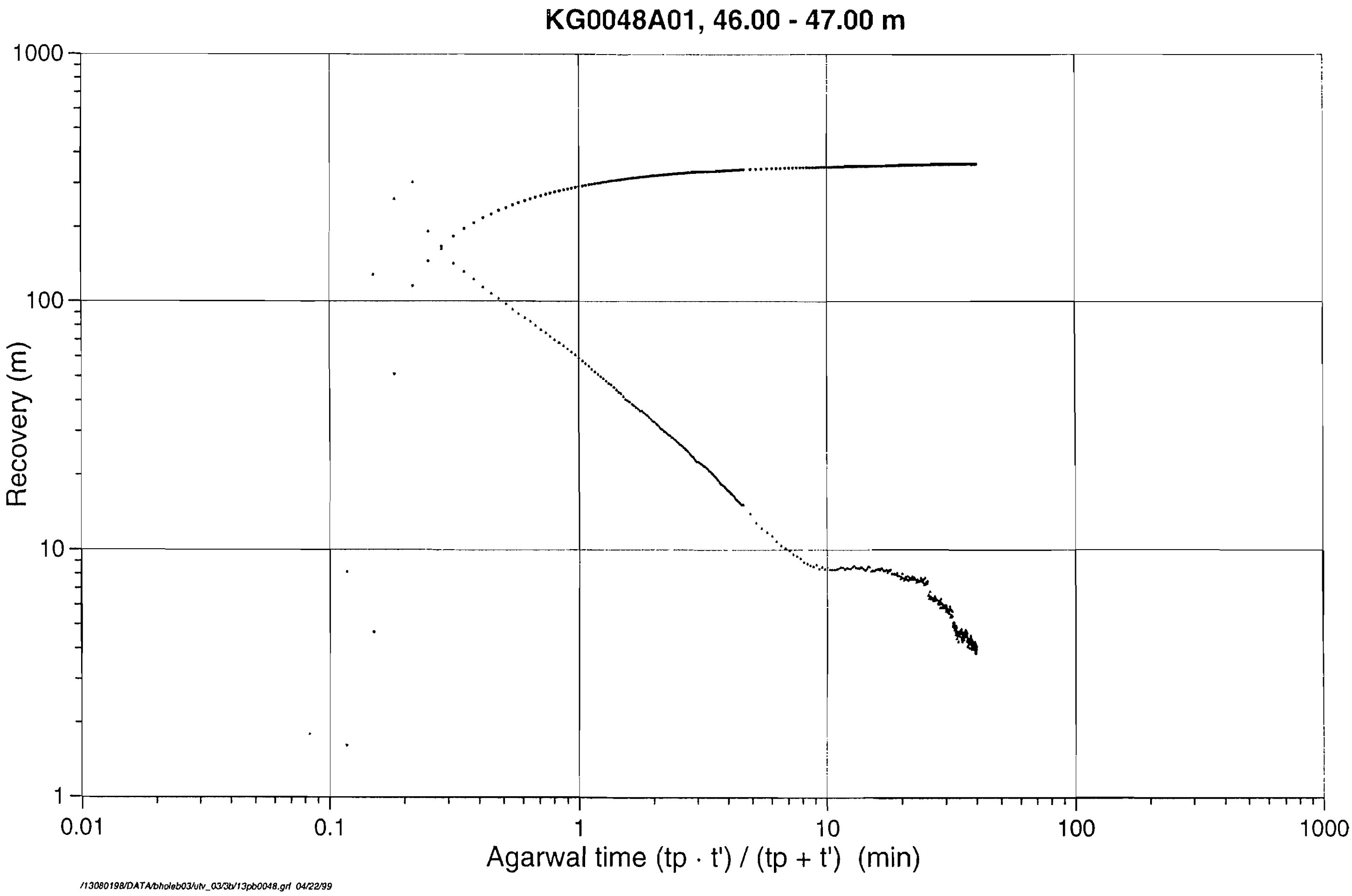
/13080198/DATA/bholeb03/utv_03/3b/11pl0048.grf 04/22/99



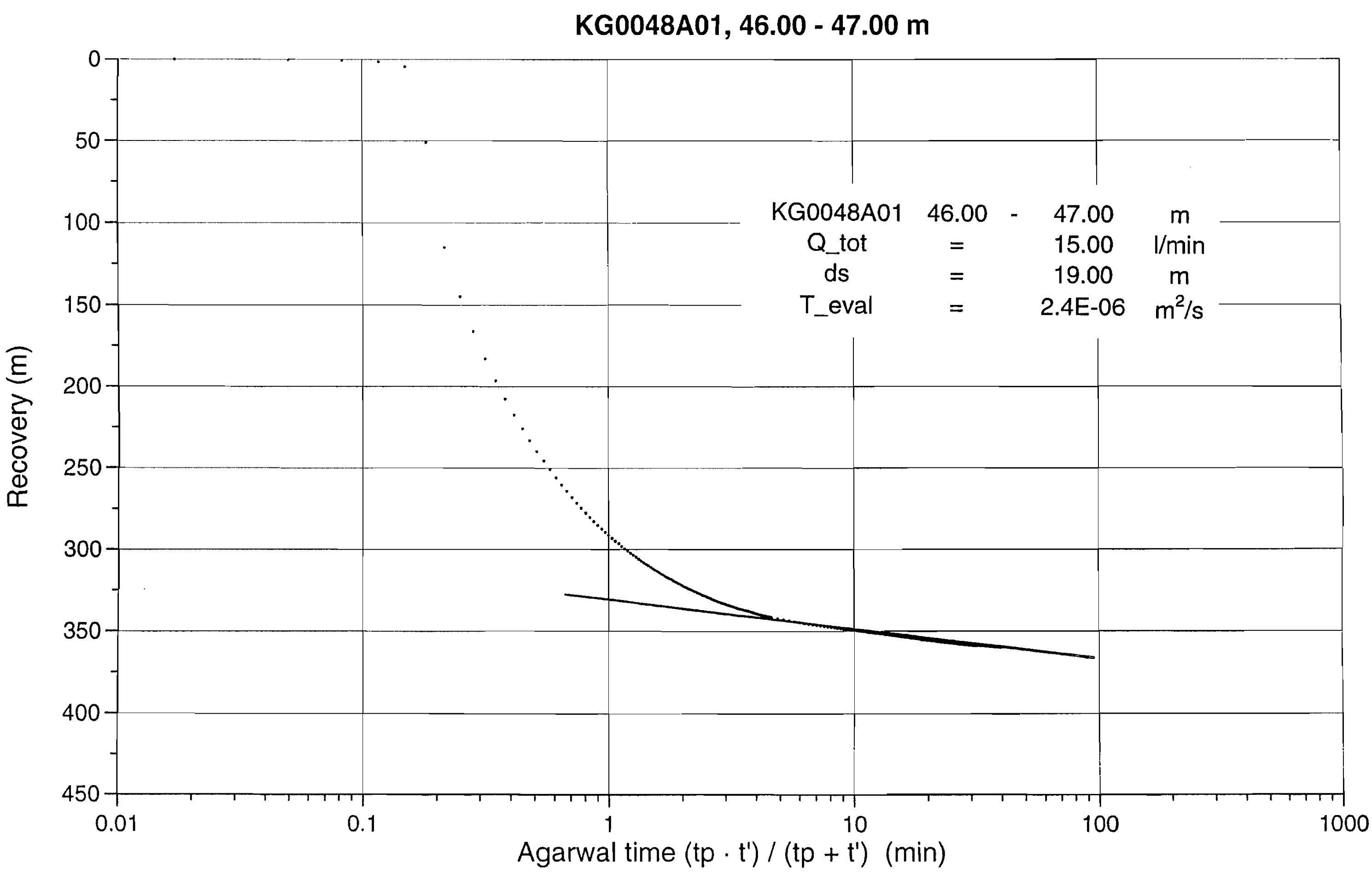
KG0048A01, 45.00 - 46.00 m
Recovery (m)
Agarwal time (tp · t') / (tp + t') (min)
1000
100
10
1
0.01
0.1
1
10
100
1000
/13080198/DATA/bholeb03/utv_03/3b/12pb0048.grf 04/22/99



KG0048A01, 45.00 - 46.00 m
Recovery (m)
Agarwal time (tp · t') / (tp + t') (min)
335
340
345
350
355
360
365
0.01
0.1
1
10
100
1000
KG0048A01 45.00 - 46.00 m
Q_tot = 21.89 l/min
ds = 23.50 m
T_eval = 2.8E-06 m²/s
/13080198/DATA/bholeb03/utv_03/3b/12pl0048.grf 04/22/99

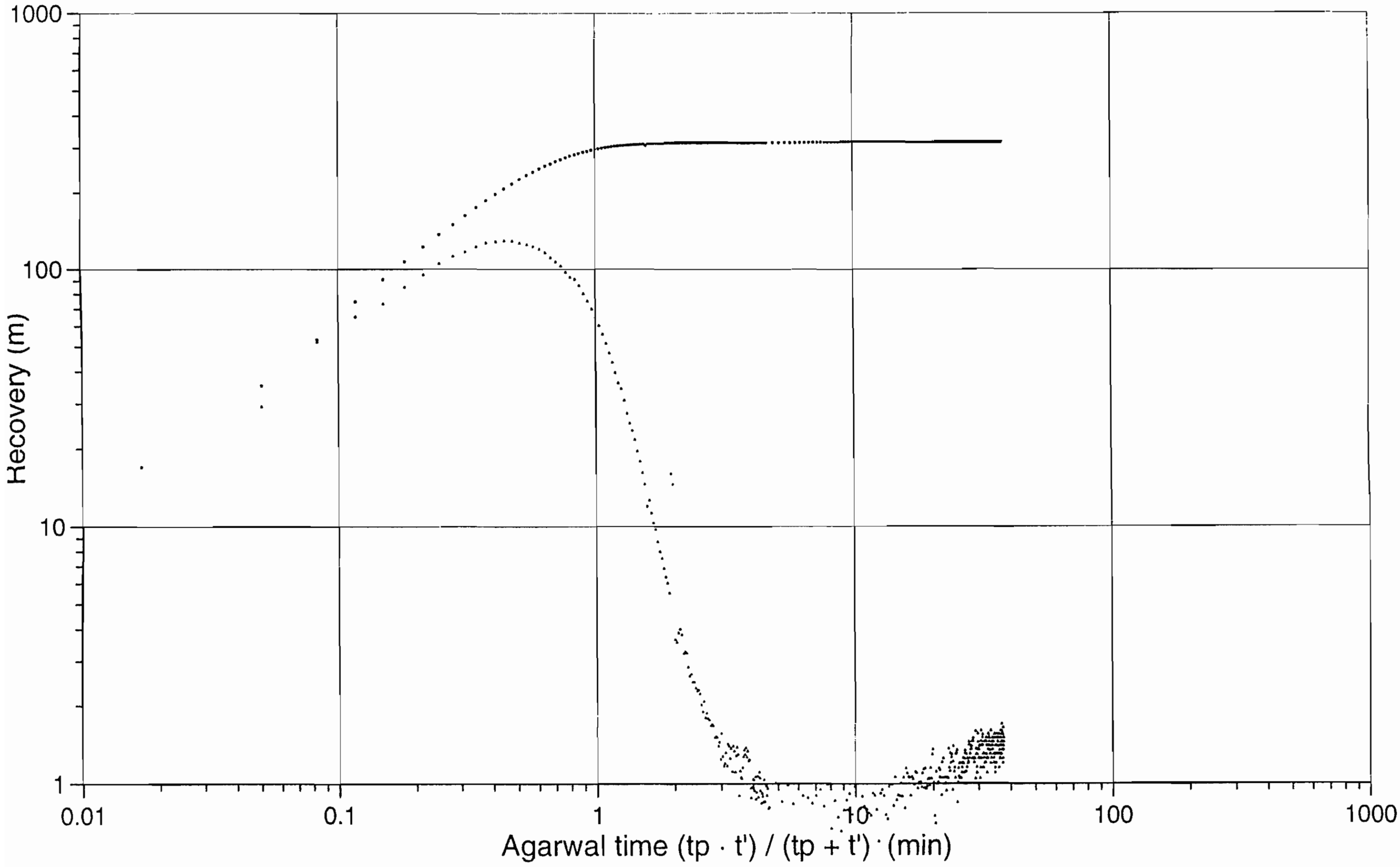


KG0048A01, 46.00 - 47.00 m
1000
100
10
1
Recovery (m)
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/13pb0048.grf 04/22/99



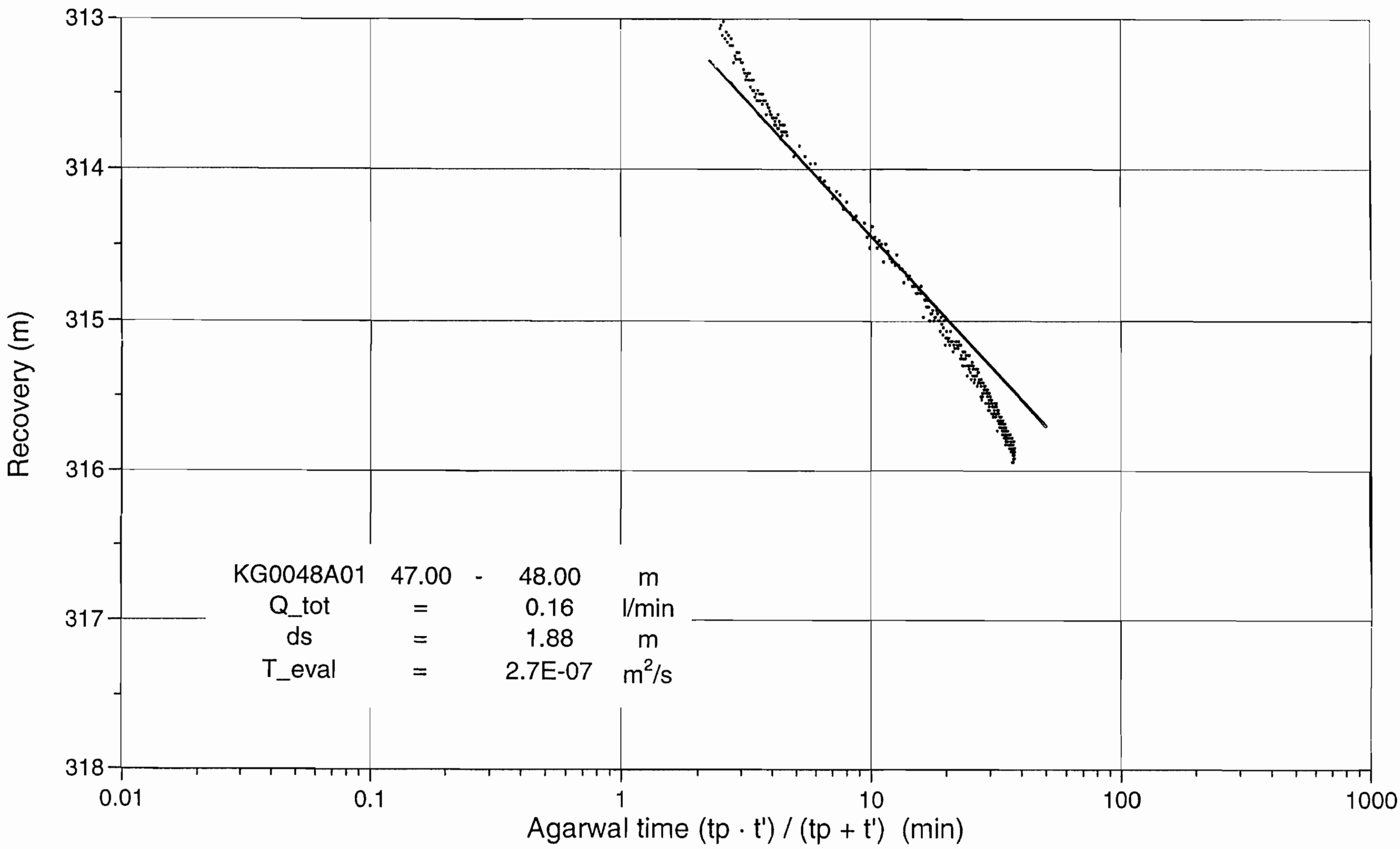
KG0048A01, 46.00 - 47.00 m
KG0048A01 46.00 - 47.00 m
Q_tot = 15.00 l/min
ds = 19.00 m
T_eval = 2.4E-06 m²/s
0
50
100
150
200
250
300
350
400
450
Recovery (m)
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/13pl0048.grf 04/22/99

KG0048A01, 47.00 - 48.00 m

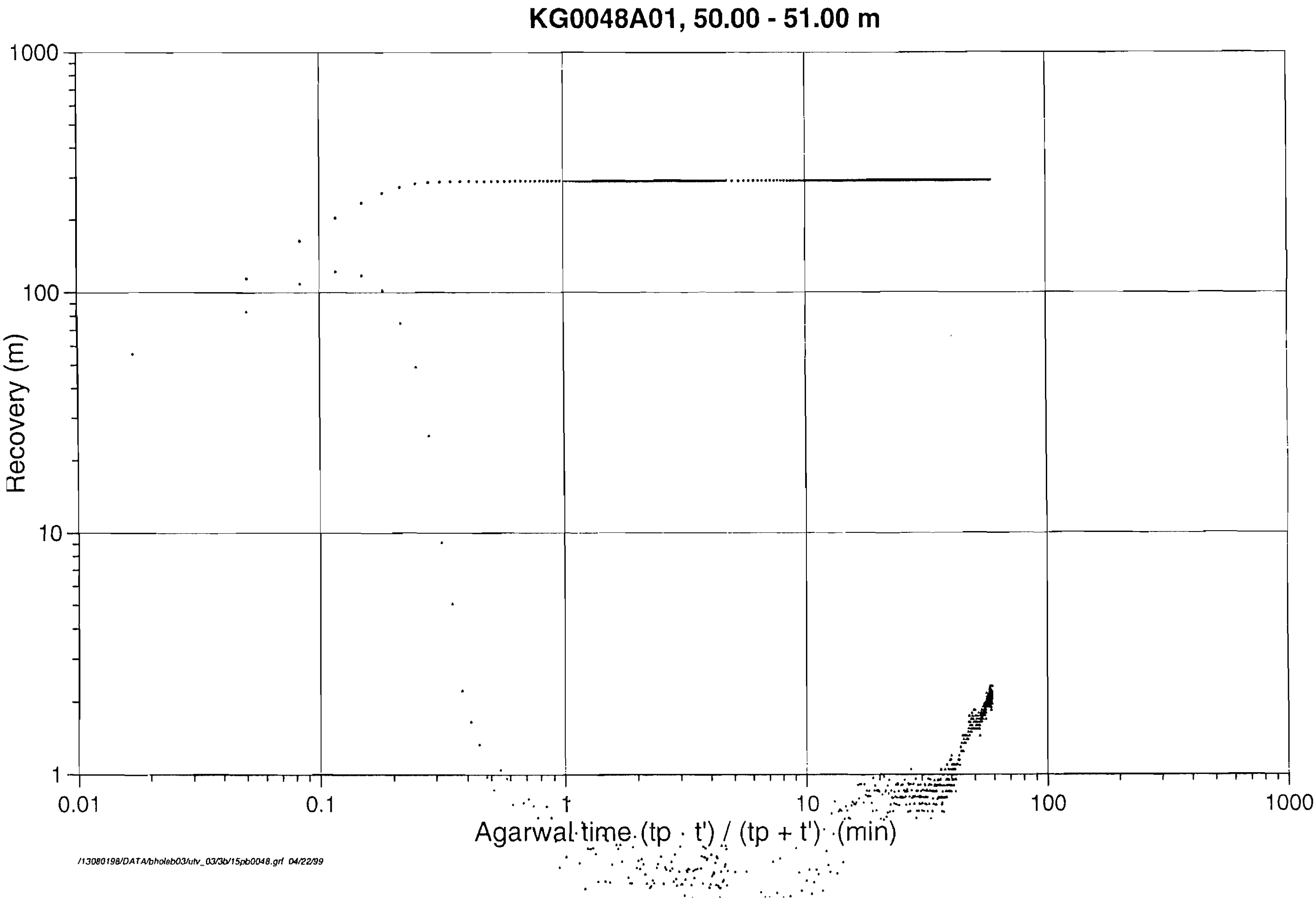


/13080198/DATA/bholeb03/utv_03/3b/14pb0048.grf 04/22/99

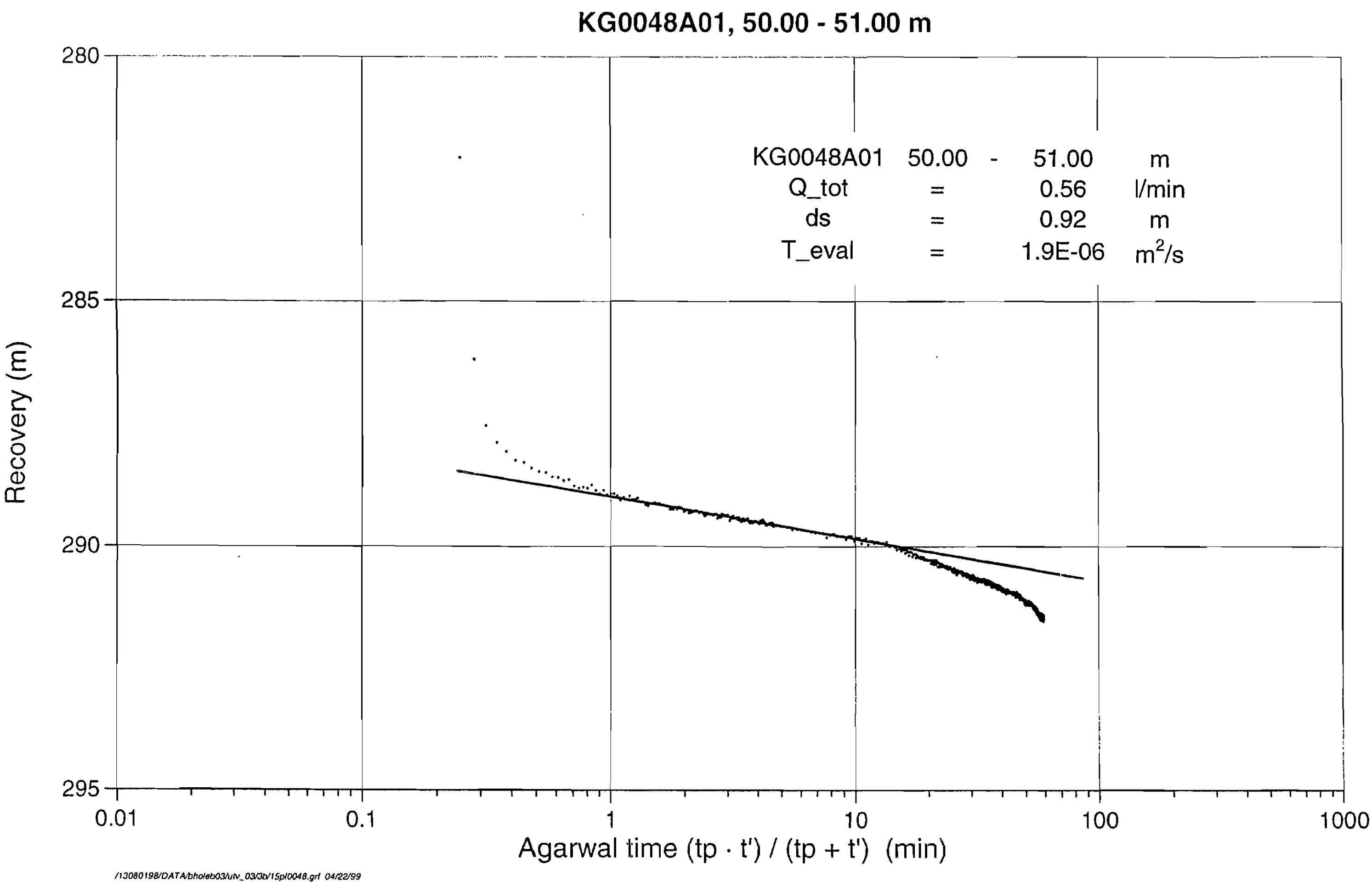
KG0048A01, 47.00 - 48.00 m



/13080198/DATA/bholeb03/utv_03/3b/14pl0048.grf 04/23/99

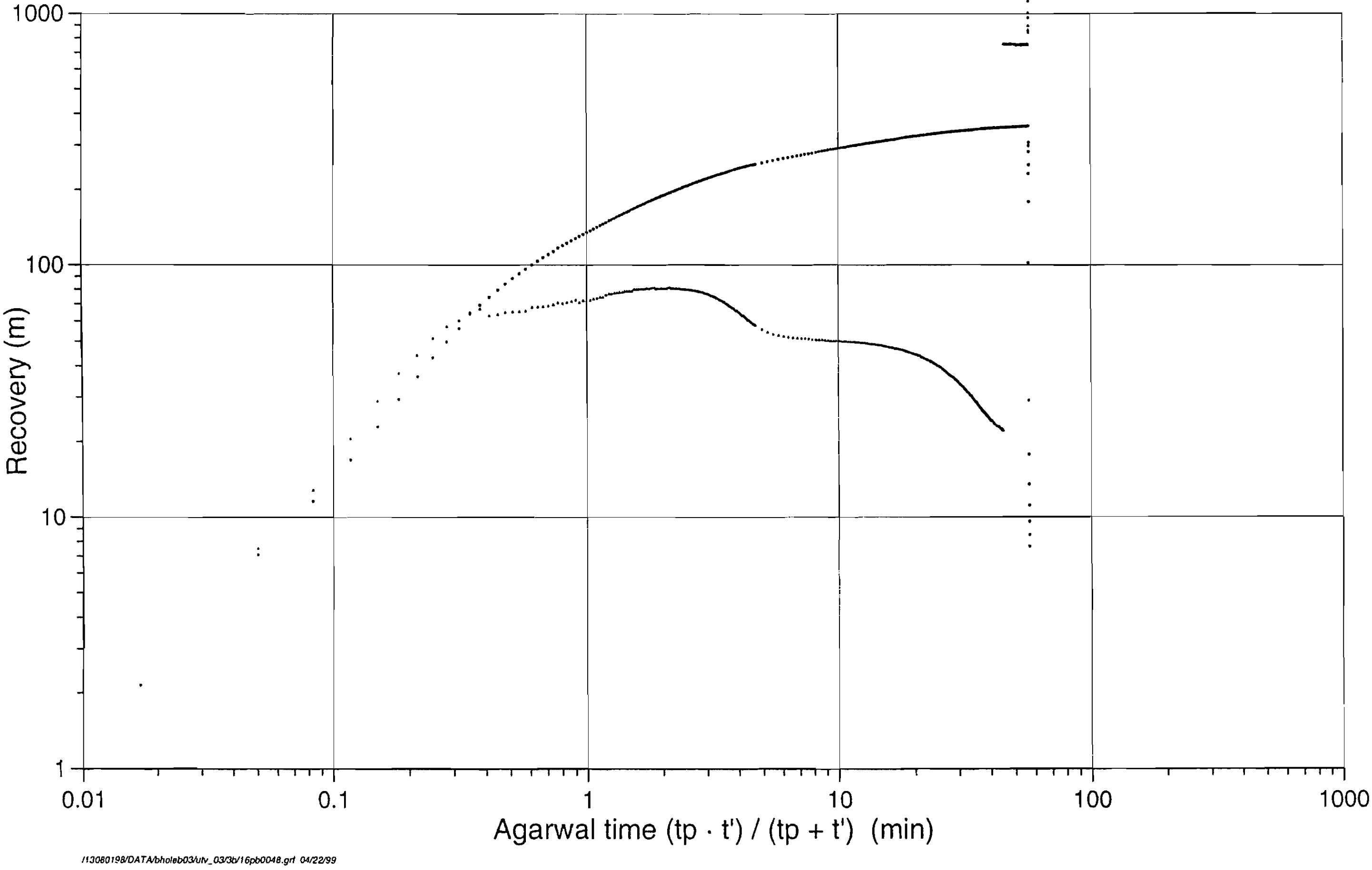


KG0048A01, 50.00 - 51.00 m
1000
100
10
1
Recovery (m)
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/15pb0048.grf 04/22/99

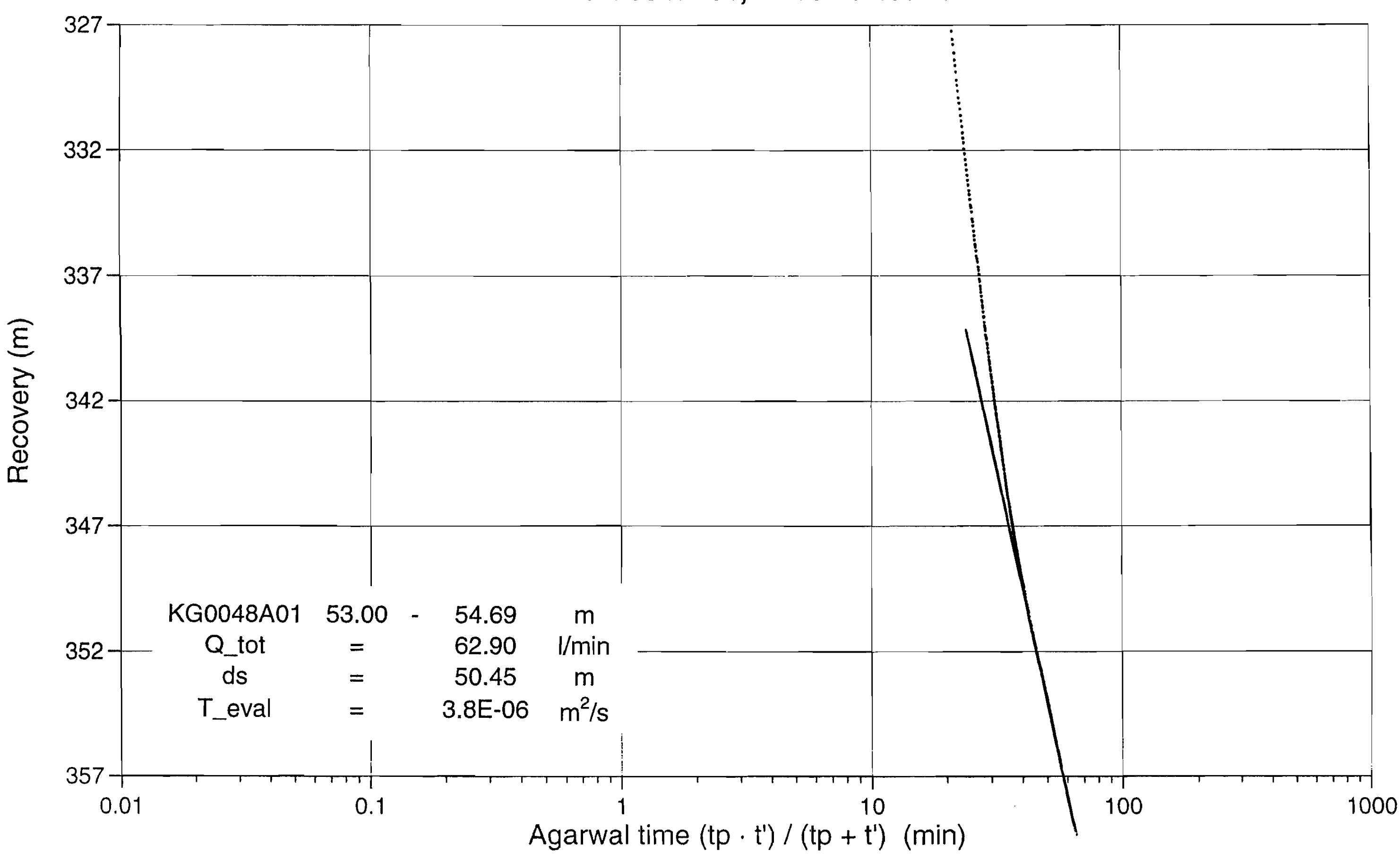


KG0048A01, 50.00 - 51.00 m
280
285
290
295
Recovery (m)
KG0048A01 50.00 - 51.00 m
Q_tot = 0.56 l/min
ds = 0.92 m
T_eval = 1.9E-06 m2/s
0.01
0.1
1
10
100
1000
Agarwal time (tp · t') / (tp + t') (min)
/13080198/DATA/bholeb03/utv_03/3b/15pl0048.grf 04/22/99

KG0048A01, 53.00 - 54.69 m



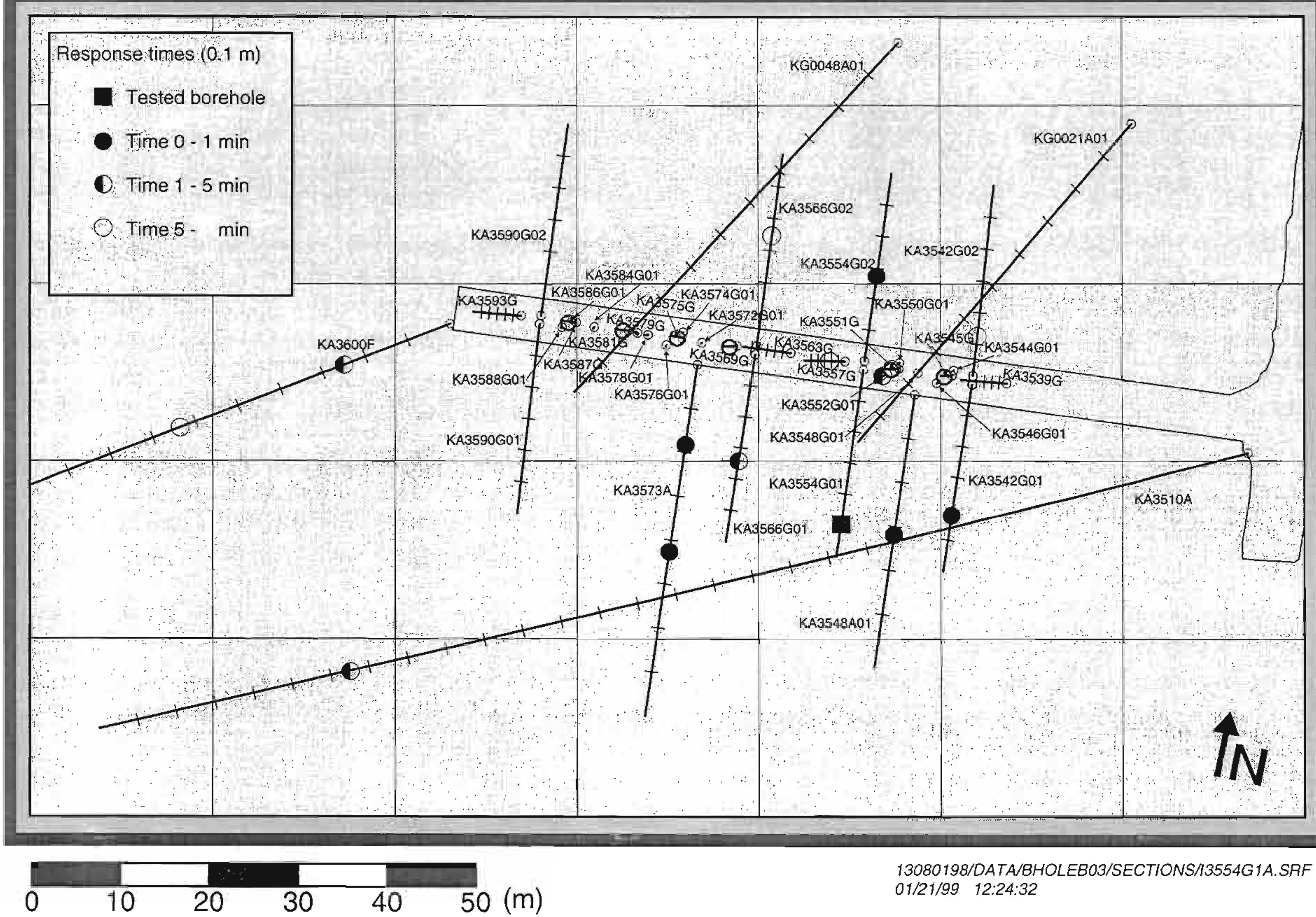
KG0048A01, 53.00 - 54.69 m



ÄSPÖ HARD ROCK LABORATORY

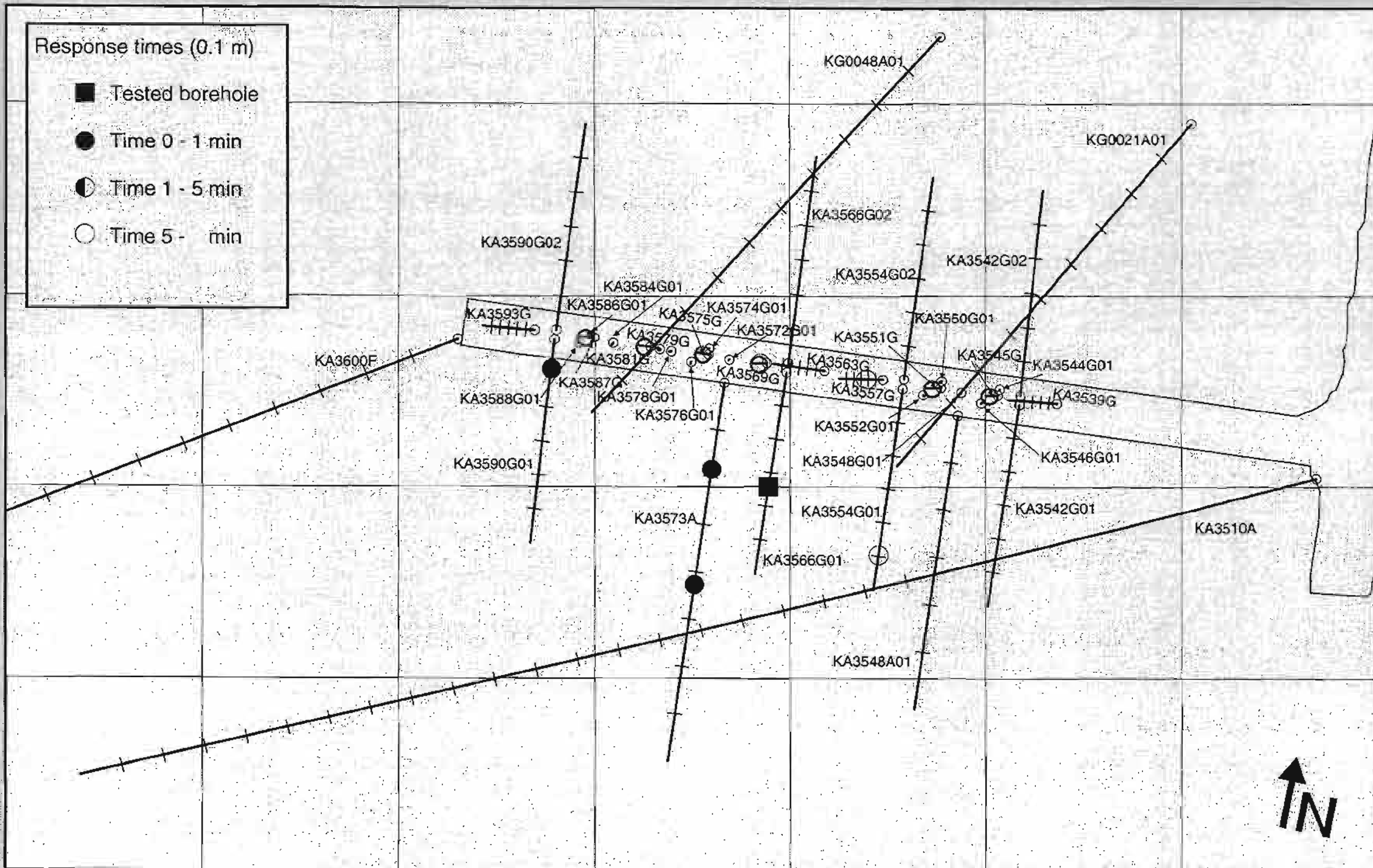
Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b

Pressure responses during interferencetest of KA3554G01.



13080198/DATA/BHOLEB03/SECTIONS/I3554G1A.SRF
01/21/99 12:24:32

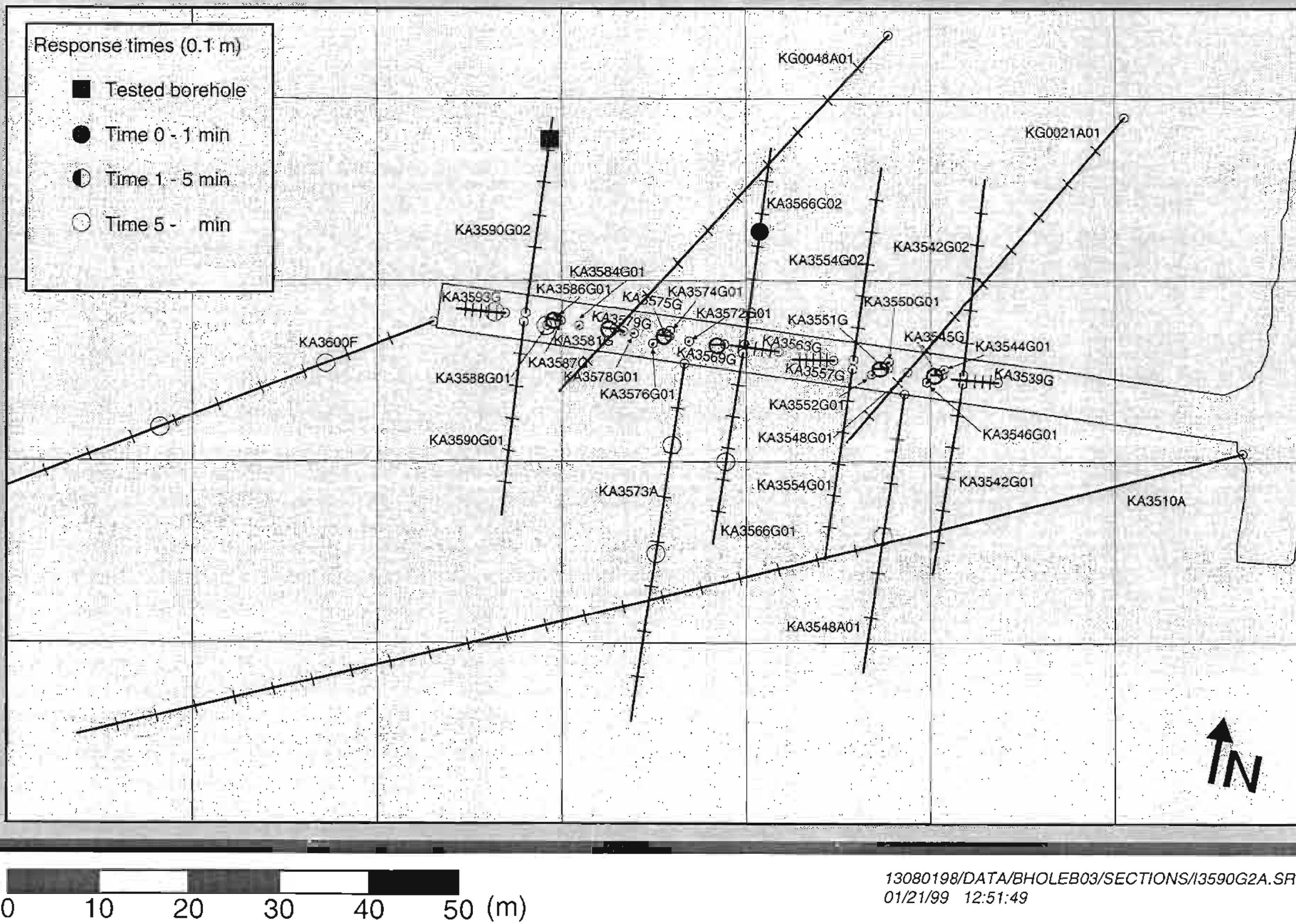
ÄSPÖ HARD ROCK LABORATORY
Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b
Pressure responses during interferencetest of KA3566G01.



0 10 20 30 40 50 (m)

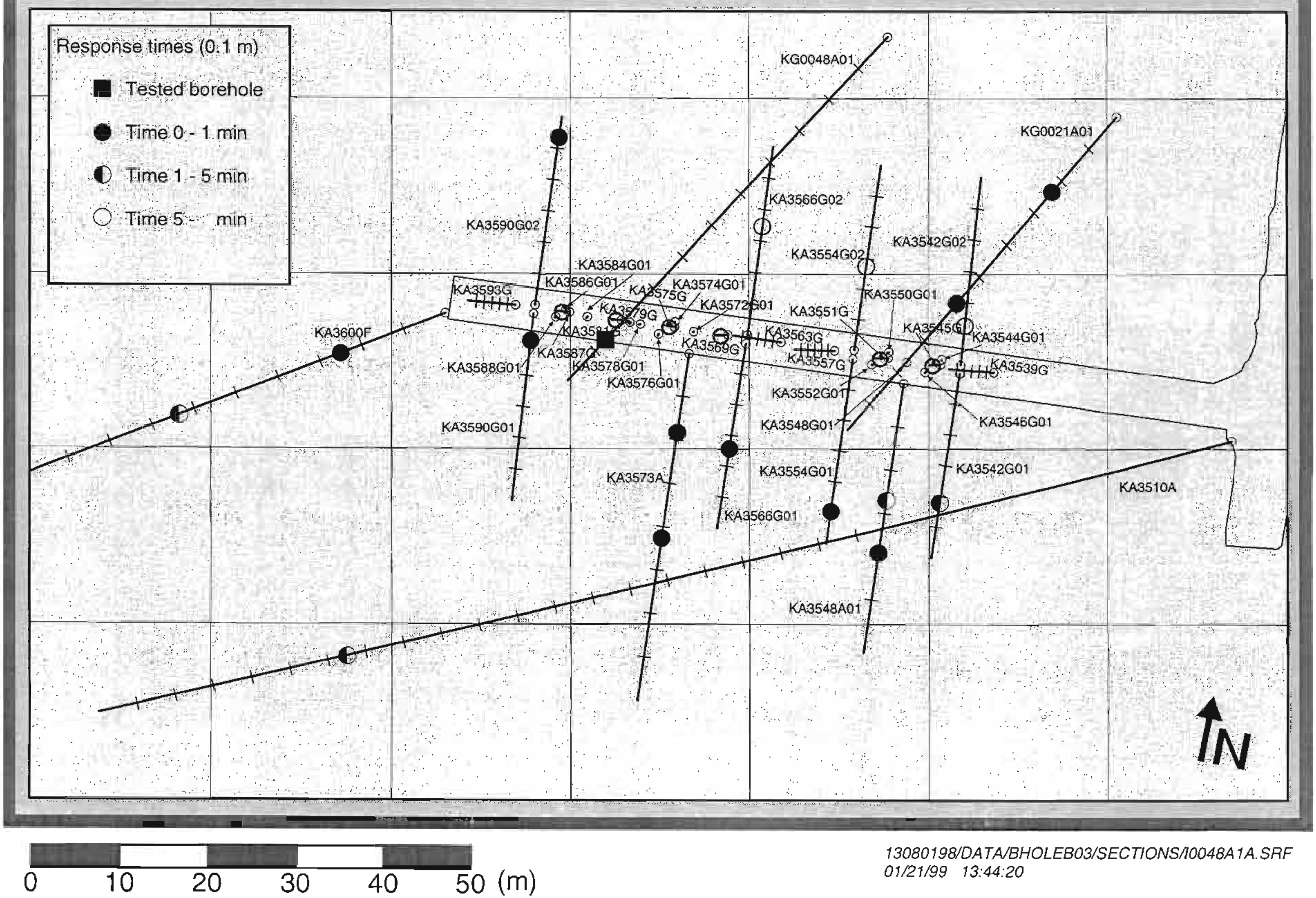
13080198/DATA/BHOLEB03/SECTIONS/I3566G1A.SRF
01/21/99 12:39:37

ÄSPÖ HARD ROCK LABORATORY
Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b
Pressure responses during interferencetest of KA3590G02.



13080198/DATA/BHOLEB03/SECTIONS/I3590G2A.SRF
01/21/99 12:51:49

ÄSPÖ HARD ROCK LABORATORY
Boreholes used during prototype repository drill campaigns 1, 2, 3a & 3b
Pressure responses during interferencetest of KG0048A01.



13080198/DATA/BHOLEB03/SECTIONS/I0048A1A.SRF
01/21/99 13:44:20

APPENDIX 4

Hydraulic conductivity around the tunnel

In this appendix the detailed analysis results are presented for the hydraulic conductivity around the tunnel.

The dataanalysis sheets are organised with 3 pages per subclass as defined in chapter 6.3

- All boreholes (First 3 pages)
- Subvertical boreholes (In the datasheets marked Location = 1)
- Subhorizontal boreholes (In the datasheets marked Location = 2)
- Southerly inclined boreholes (In the datasheets marked Location = 3)
- Northerly inclined boreholes (In the datasheets marked Location = 4)

Data variable : Seclow - Secup < 1.5 m : 1 m sections

Data variable : Seclow - Secup > 1.5 m : 3 m sections

Data variable : Seclow - Secup = Log_K3m : 1 m and 3 m sections

K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:32

Analysis Summary

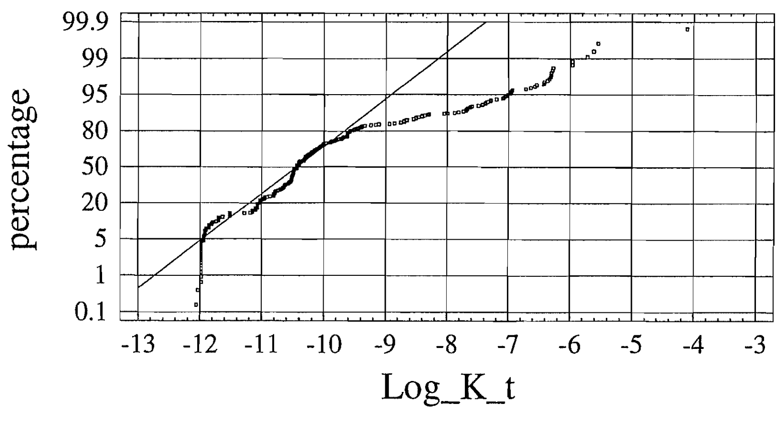
Data variable: Log_K_t
Selection variable: SECLOW - SECUP <= 1.5

384 values ranging from -12.06 to -4.11

Summary Statistics for Log_K_t

Count = 384
Average = -10.0732
Median = -10.43
Mode = -11.98
Geometric mean =
Variance = 2.19491
Standard deviation = 1.48152
Standard error = 0.0756037
Minimum = -12.06
Maximum = -4.11
Range = 7.95
Lower quartile = -10.955
Upper quartile = -9.62
Interquartile range = 1.335
Skewness = 1.22599
Stnd. skewness = 9.80794
Kurtosis = 1.26993
Stnd. kurtosis = 5.0797
Coeff. of variation = -14.7075%
Sum = -3868.12

Normal Probability Plot for Log_K_t



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:31

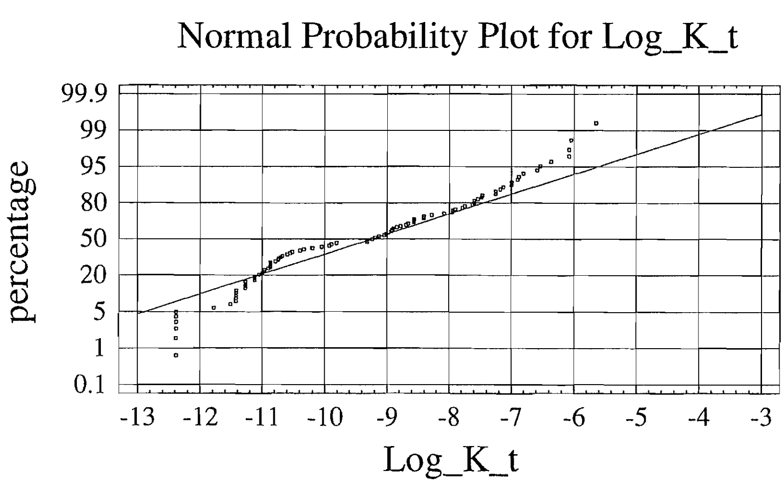
Analysis Summary

Data variable: Log_K_t
Selection variable: SECLOW - SECUP >1.5

93 values ranging from -12.38 to -5.65

Summary Statistics for Log_K_t

Count = 93
Average = -9.3828
Median = -9.24
Mode = -12.38
Geometric mean =
Variance = 3.36167
Standard deviation = 1.83349
Standard error = 0.190124
Minimum = -12.38
Maximum = -5.65
Range = 6.73
Lower quartile = -10.96
Upper quartile = -7.79
Interquartile range = 3.17
Skewness = 0.161663
Stnd. skewness = 0.636467
Kurtosis = -1.12625
Stnd. kurtosis = -2.21703
Coeff. of variation = -19.5409%
Sum = -872.6



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:31

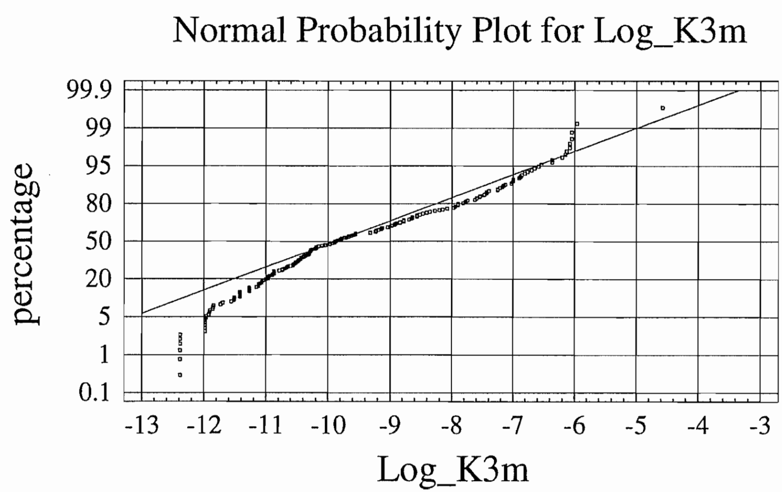
Analysis Summary

Data variable: Log_K3m

200 values ranging from -12.38 to -4.58

Summary Statistics for Log_K3m

Count = 200
Average = -9.5016
Median = -9.88
Mode = -12.38
Geometric mean =
Variance = 3.10277
Standard deviation = 1.76147
Standard error = 0.124555
Minimum = -12.38
Maximum = -4.58
Range = 7.8
Lower quartile = -10.88
Upper quartile = -8.025
Interquartile range = 2.855
Skewness = 0.395631
Stnd. skewness = 2.28418
Kurtosis = -0.785726
Stnd. kurtosis = -2.2682
Coeff. of variation = -18.5387%
Sum = -1900.32



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:29

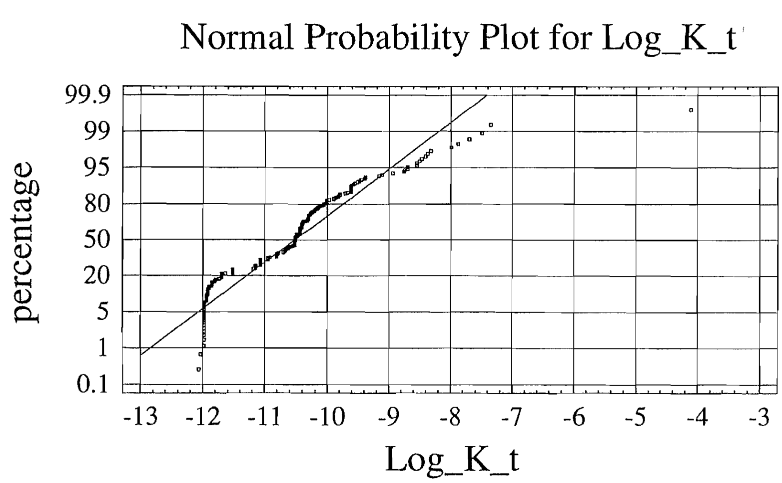
Analysis Summary

Data variable: Log_K_t
Selection variable: (SECLOW - SECUP <= 1.5) & (Location = 1)

228 values ranging from -12.06 to -4.11

Summary Statistics for Log_K_t

Count = 228
Average = -10.5811
Median = -10.51
Mode = -11.98
Geometric mean =
Variance = 1.18456
Standard deviation = 1.08838
Standard error = 0.0720794
Minimum = -12.06
Maximum = -4.11
Range = 7.95
Lower quartile = -11.52
Upper quartile = -10.165
Interquartile range = 1.355
Skewness = 1.34469
Stnd. skewness = 8.28922
Kurtosis = 5.09375
Stnd. kurtosis = 15.7
Coeff. of variation = -10.2861%
Sum = -2412.48



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:28

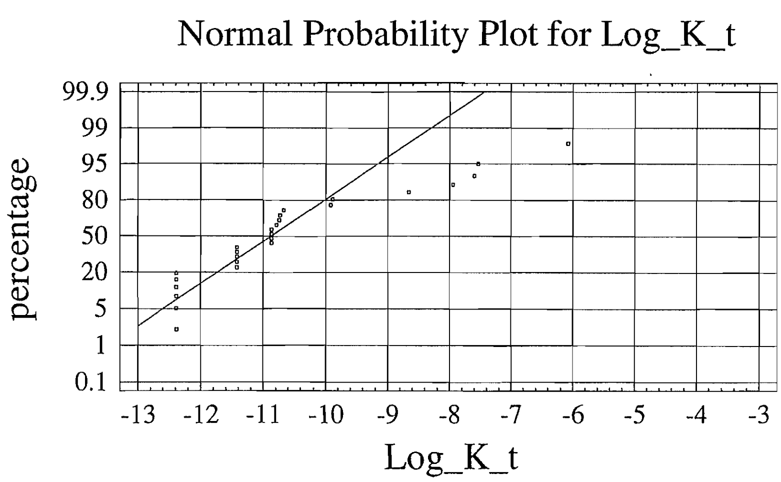
Analysis Summary

Data variable: Log_K_t
Selection variable: (SECLOW - SECUP >1.5) & (Location = 1)

26 values ranging from -12.38 to -6.08

Summary Statistics for Log_K_t

Count = 26
Average = -10.5935
Median = -10.87
Mode = -12.38
Geometric mean =
Variance = 2.93148
Standard deviation = 1.71216
Standard error = 0.335781
Minimum = -12.38
Maximum = -6.08
Range = 6.3
Lower quartile = -11.42
Upper quartile = -9.92
Interquartile range = 1.5
Skewness = 1.17812
Stnd. skewness = 2.45245
Kurtosis = 0.799913
Stnd. kurtosis = 0.832576
Coeff. of variation = -16.1624%
Sum = -275.43



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:29

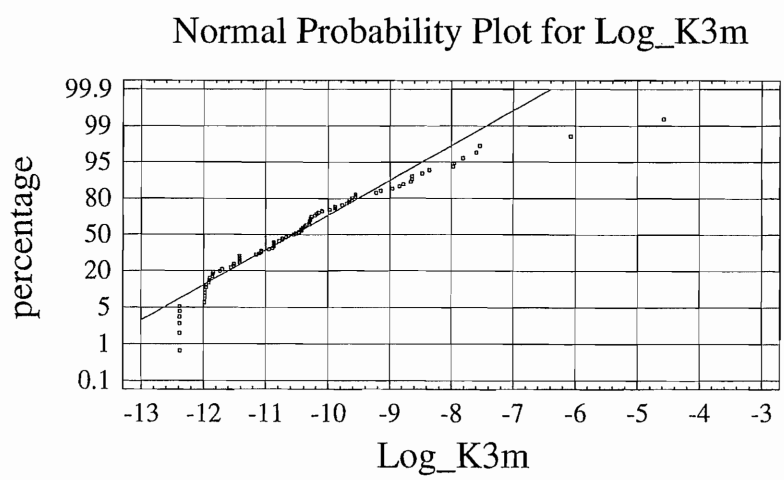
Analysis Summary

Data variable: Log_K3m
Selection variable: Location = 1

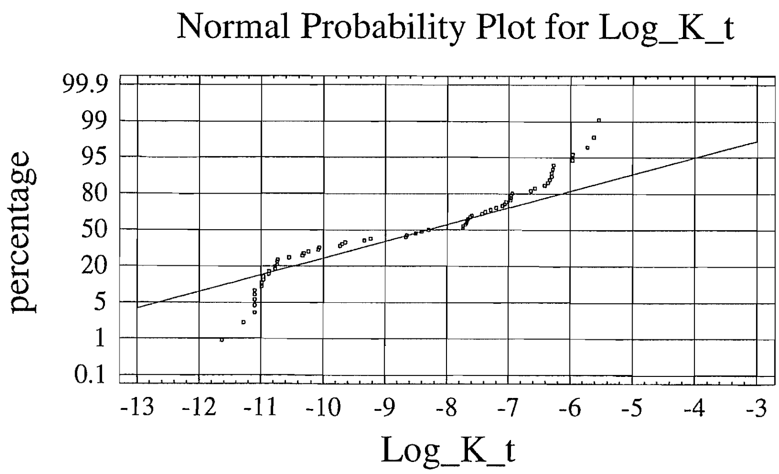
89 values ranging from -12.38 to -4.58

Summary Statistics for Log_K3m

Count = 89
Average = -10.4307
Median = -10.55
Mode = -12.38
Geometric mean =
Variance = 2.15479
Standard deviation = 1.46792
Standard error = 0.155599
Minimum = -12.38
Maximum = -4.58
Range = 7.8
Lower quartile = -11.52
Upper quartile = -9.7
Interquartile range = 1.82
Skewness = 1.20144
Stnd. skewness = 4.62722
Kurtosis = 2.24931
Stnd. kurtosis = 4.3315
Coeff. of variation = -14.0731%
Sum = -928.33



```
K_3m_1.sgp (K_3m_1.sf3)
1999-04-20  5:30


Analysis Summary

Data variable: Log_K_t
Selection variable: (SECLOW - SECUP <= 1.5) & (Location = 2)

67 values ranging from -11.63 to -5.55




Summary Statistics for Log_K_t

Count = 67
Average = -8.59179
Median = -8.3
Mode = -11.1
Geometric mean =
Variance = 3.65297
Standard deviation = 1.91127
Standard error = 0.233499
Minimum = -11.63
Maximum = -5.55
Range = 6.08
Lower quartile = -10.74
Upper quartile = -6.96
Interquartile range = 3.78
Skewness = -0.075023
Stnd. skewness = -0.250701
Kurtosis = -1.53928
Stnd. kurtosis = -2.57187
Coeff. of variation = -22.2453%
Sum = -575.65
```



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:30

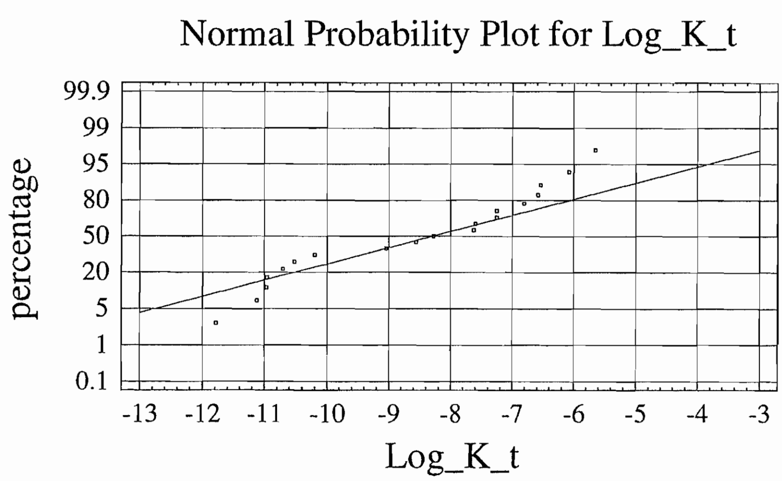
Analysis Summary

Data variable: Log_K_t
Selection variable: (SECLOW - SECUP >1.5) & (Location = 2)

19 values ranging from -11.78 to -5.65

Summary Statistics for Log_K_t

Count = 19
Average = -8.60684
Median = -8.28
Mode = -7.25
Geometric mean =
Variance = 3.92939
Standard deviation = 1.98227
Standard error = 0.454764
Minimum = -11.78
Maximum = -5.65
Range = 6.13
Lower quartile = -10.7
Upper quartile = -6.81
Interquartile range = 3.89
Skewness = -0.179724
Stnd. skewness = -0.319822
Kurtosis = -1.49572
Stnd. kurtosis = -1.33082
Coeff. of variation = -23.0313%
Sum = -163.53



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:27

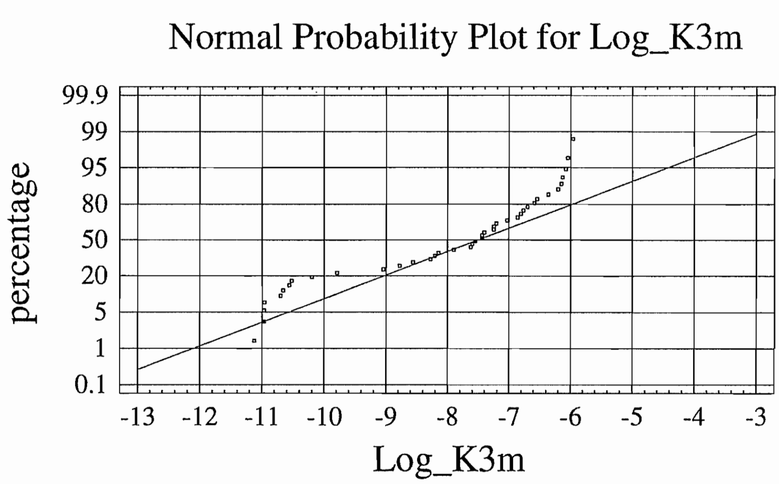
Analysis Summary

Data variable: Log_K3m
Selection variable: Location = 2

40 values ranging from -11.12 to -5.96

Summary Statistics for Log_K3m

Count = 40
Average = -8.05925
Median = -7.495
Mode =
Geometric mean =
Variance = 2.87651
Standard deviation = 1.69603
Standard error = 0.268166
Minimum = -11.12
Maximum = -5.96
Range = 5.16
Lower quartile = -9.415
Upper quartile = -6.735
Interquartile range = 2.68
Skewness = -0.641592
Stnd. skewness = -1.65658
Kurtosis = -0.983314
Stnd. kurtosis = -1.26945
Coeff. of variation = -21.0445%
Sum = -322.37



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:30

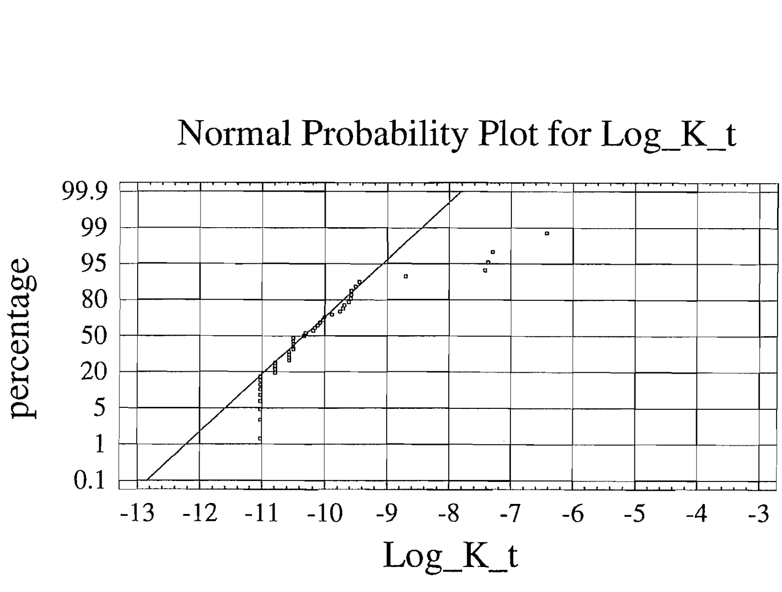
Analysis Summary

Data variable: Log_K_t
Selection variable: (SECLOW - SECUP <= 1.5) & (Location = 3)

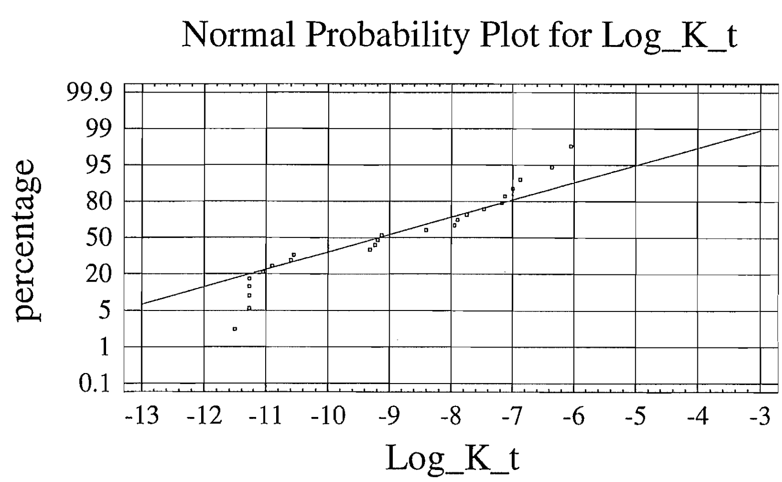
45 values ranging from -11.03 to -6.42

Summary Statistics for Log_K_t

Count = 45
Average = -10.0451
Median = -10.33
Mode = -11.03
Geometric mean =
Variance = 1.17182
Standard deviation = 1.0825
Standard error = 0.16137
Minimum = -11.03
Maximum = -6.42
Range = 4.61
Lower quartile = -10.79
Upper quartile = -9.69
Interquartile range = 1.1
Skewness = 1.82399
Stnd. skewness = 4.99522
Kurtosis = 3.25941
Stnd. kurtosis = 4.46313
Coeff. of variation = -10.7764%
Sum = -452.03



```
K_3m_1.sgp (K_3m_1.sf3)
1999-04-20  5:29

Analysis Summary

Data variable: Log_K_t
Selection variable: (SECLOW - SECUP >1.5) & (Location = 3)

24 values ranging from -11.51 to -6.05



Summary Statistics for Log_K_t

Count = 24
Average = -9.02708
Median = -9.16
Mode = -11.27
Geometric mean =
Variance = 3.36617
Standard deviation = 1.83471
Standard error = 0.374509
Minimum = -11.51
Maximum = -6.05
Range = 5.46
Lower quartile = -10.975
Upper quartile = -7.325
Interquartile range = 3.65
Skewness = 0.0210161
Stnd. skewness = 0.0420322
Kurtosis = -1.52489
Stnd. kurtosis = -1.52489
Coeff. of variation = -20.3245%
Sum = -216.65
```



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:28

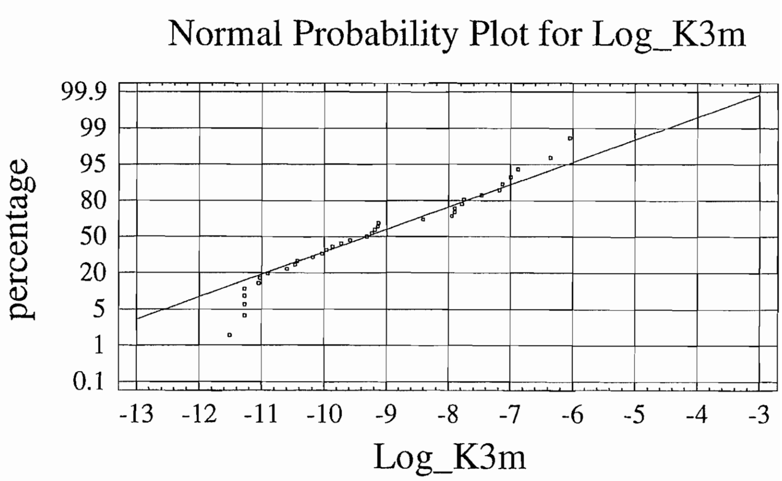
Analysis Summary

Data variable: Log_K3m
Selection variable: Location = 3

35 values ranging from -11.51 to -6.05

Summary Statistics for Log_K3m

Count = 35
Average = -9.20686
Median = -9.32
Mode = -11.27
Geometric mean =
Variance = 2.63708
Standard deviation = 1.62391
Standard error = 0.27449
Minimum = -11.51
Maximum = -6.05
Range = 5.46
Lower quartile = -10.6
Upper quartile = -7.78
Interquartile range = 2.82
Skewness = 0.29008
Stnd. skewness = 0.70061
Kurtosis = -1.15445
Stnd. kurtosis = -1.39413
Coeff. of variation = -17.638%
Sum = -322.24



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:28

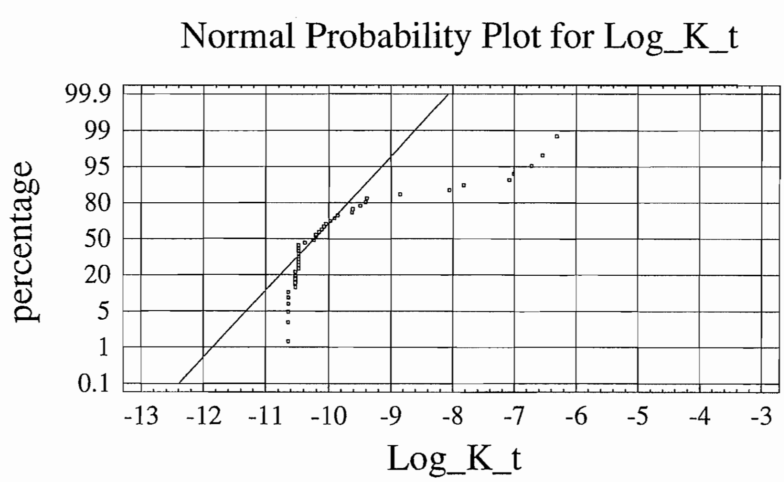
Analysis Summary

Data variable: Log_K_t
Selection variable: (SECLOW - SECUP <= 1.5) & (Location = 4)

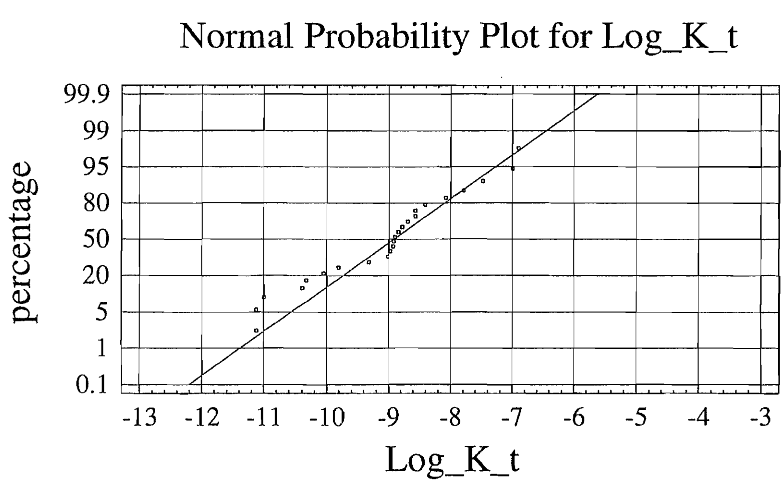
44 values ranging from -10.64 to -6.31

Summary Statistics for Log_K_t

Count = 44
Average = -9.72636
Median = -10.23
Mode = -10.48
Geometric mean =
Variance = 1.57981
Standard deviation = 1.2569
Standard error = 0.189486
Minimum = -10.64
Maximum = -6.31
Range = 4.33
Lower quartile = -10.505
Upper quartile = -9.56
Interquartile range = 0.945
Skewness = 1.69845
Stnd. skewness = 4.59942
Kurtosis = 1.66229
Stnd. kurtosis = 2.25076
Coeff. of variation = -12.9227%
Sum = -427.96



```
K_3m_1.sgp (K_3m_1.sf3)
1999-04-20  5:31


Analysis Summary

Data variable: Log_K_t
Selection variable: (SECLOW - SECUP >1.5) & (Location = 4)

24 values ranging from -11.12 to -6.9




Summary Statistics for Log_K_t

Count = 24
Average = -9.04125
Median = -8.91
Mode =
Geometric mean =
Variance = 1.4109
Standard deviation = 1.18781
Standard error = 0.242461
Minimum = -11.12
Maximum = -6.9
Range = 4.22
Lower quartile = -9.93
Upper quartile = -8.49
Interquartile range = 1.44
Skewness = -0.171653
Stnd. skewness = -0.343306
Kurtosis = -0.38766
Stnd. kurtosis = -0.38766
Coeff. of variation = -13.1377%
Sum = -216.99
```



K_3m_1.sgp (K_3m_1.sf3)
1999-04-20 5:31

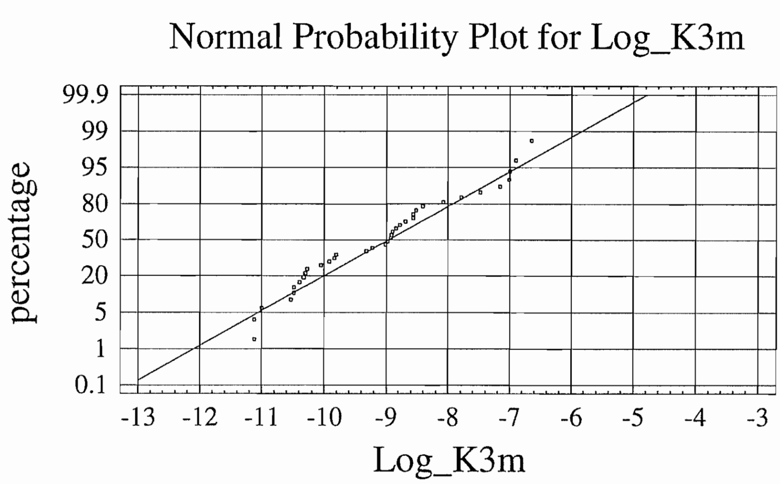
Analysis Summary

Data variable: Log_K3m
Selection variable: Location = 4

36 values ranging from -11.12 to -6.65

Summary Statistics for Log_K3m

Count = 36
Average = -9.09389
Median = -8.955
Mode =
Geometric mean =
Variance = 1.62638
Standard deviation = 1.2753
Standard error = 0.212549
Minimum = -11.12
Maximum = -6.65
Range = 4.47
Lower quartile = -10.29
Upper quartile = -8.465
Interquartile range = 1.825
Skewness = 0.254341
Stnd. skewness = 0.623007
Kurtosis = -0.815514
Stnd. kurtosis = -0.998796
Coeff. of variation = -14.0237%
Sum = -327.38



APPENDIX 5

Distance between features

In this appendix the detailed analysis results are presented for each of the five datasets as described in chapter 6.4. Normal probability plots for the Log_{10} (distance between features) for features with T > T(specified value) are also shown for data set 1.

L	=	Total length of synthetic borehole	(m)
n	=	sample size	(-)
D_a	=	arithmetic mean distance	(m)
D_{median}	=	median distance	(m)
D_g	=	geometric mean distance	(m)
$S(Log_{10} D)$	=	standard deviation of $Log_{10}(D)$	

In the diagrams the line is running through the median value and the slope is determined by the quartiles.

Table A5-1 Distance between hydraulic features with T > 10^{-11}, T > 10^{-10}, T >10^{-9}, T >10^{-8}, T > 10^{-7} and T > 10^{-6} m^2/s respectively. Data set 1.

DATASET 1

Subclass		LogT>-6	LogT>-7	LogT>-8	LogT>-9	LogT>-10	LogT>-11
L=	n	11	40	79	117	175	377
700.99	Da	63.73	17.52	8.87	5.99	4.01	1.86
1-ALL	Dmedian	10.23	3.02	3.02	3.02	3.02	1.00
	Dg	13.43	5.94	3.26	3.21	2.44	1.42
	S(Log10 Dg)	0.89	0.61	0.54	0.45	0.39	0.26
L=	n	2	2	10	23	52	172
327.58	Da	163.79	163.79	32.76	14.24	6.30	1.90
2-VERT	Dmedian	56.89	56.89	3.51	4.07	2.00	1.00
	Dg	56.89	56.89	7.85	5.94	3.01	1.29
	S(Log10 Dg)	1.05	1.05	0.74	0.61	0.51	0.28
L=	n	7	25	43	50	56	78
133.52	Da	19.07	5.34	3.11	2.67	2.38	1.71
3-HOR	Dmedian	3.98	3.02	1.00	1.00	1.00	1.00
	Dg	6.81	3.41	2.02	1.89	1.74	1.43
	S(Log10 Dg)	0.74	0.42	0.37	0.34	0.32	0.24
L=	n	2	8	15	20	30	59
120	Da	60.00	15.00	8.00	6.00	4.00	2.03
4-SOUTH	Dmedian	18.84	3.02	3.02	3.02	3.02	1.00
	Dg	18.84	6.29	4.41	4.25	2.98	1.70
	S(Log10 Dg)	1.12	0.53	0.46	0.36	0.34	0.26
L=	n		5	12	25	37	64
120	Da		24.00	10.00	4.80	3.24	1.88
5-NORTH	Dmedian		30.90	3.02	3.02	3.02	1.00
	Dg		14.39	4.31	3.68	2.60	1.55
	S(Log10 Dg)		0.59	0.57	0.33	0.29	0.23

Table A5-2 Distance between hydraulic features with $T > 10^{-11}$, $T > 10^{-10}$, $T > 10^{-9}$, $T > 10^{-8}$, $T > 10^{-7}$ and $T > 10^{-6}$ m^2/s respectively. Data set 2.

DATASET 2

	LogT>-6	LogT>-7	LogT>-8	LogT>-9	LogT>-10	LogT>-11
n	11	40	80	117	175	377
Da	63.73	17.52	8.76	5.99	4.01	1.86
Dmedian	10.23	3.02	3.02	3.02	3.02	1.00
Dg	14.24	6.02	3.21	3.04	2.41	1.42
S(Log10 Dg)	0.90	0.61	0.53	0.45	0.39	0.26
n	2	2	10	23	52	172
Da	163.79	163.79	32.76	14.24	6.30	1.90
Dmedian	56.89	56.89	3.51	3.72	2.00	1.00
Dg	56.89	56.89	8.65	5.60	2.83	1.27
S(Log10 Dg)	1.05	1.05	0.74	0.62	0.50	0.26
n	7	25	43	50	56	78
Da	19.07	5.34	3.10	2.67	2.38	1.71
Dmedian	3.98	3.02	1.00	1.00	1.00	1.00
Dg	6.81	3.41	2.02	1.89	1.74	1.43
S(Log10 Dg)	0.74	0.42	0.37	0.34	0.32	0.24
n	2	8	15	20	30	59
Da	60.00	15.00	8.00	6.00	4.00	2.03
Dmedian	18.84	4.27	3.02	3.02	3.02	1.00
Dg	18.84	8.01	4.71	4.36	2.94	1.70
S(Log10 Dg)	1.12	0.52	0.45	0.35	0.33	0.26
n		5	12	25	37	64
Da		24.20	10.00	4.80	3.24	1.76
Dmedian		30.90	3.02	3.02	3.02	1.00
Dg		14.39	4.31	3.68	2.60	1.55
S(Log10 Dg)		0.59	0.57	0.33	0.29	0.23

Table A5-3 Distance between hydraulic features with T > 10^{-11}, T > 10^{-10}, T >10^{-9}, T >10^{-8}, T > 10^{-7} and T > 10^{-6} m^2/s respectively. Data set 3.

DATASET 3

	LogT>-6	LogT>-7	LogT>-8	LogT>-9	LogT>-10	LogT>-11
n	11	40	80	117	175	377
Da	63.73	15.00	8.00	6.00	4.00	2.03
Dmedian	10.23	3.02	3.02	3.02	3.02	1.00
Dg	13.24	5.78	3.26	3.08	2.43	1.42
S(Log10 Dg)	0.88	0.61	0.54	0.45	0.39	0.26
n	2	2	10	23	52	172
Da	163.79	15.00	8.00	6.00	4.00	2.03
Dmedian	56.89	56.89	3.51	3.72	2.00	1.00
Dg	56.89	56.89	9.40	5.35	2.88	1.28
S(Log10 Dg)	1.05	1.05	0.77	0.62	0.51	0.27
n	7	25	43	50	56	78
Da	19.07	15.00	8.00	6.00	4.00	2.03
Dmedian	3.98	3.02	1.00	1.00	1.00	1.00
Dg	6.81	3.41	2.02	1.89	1.74	1.43
S(Log10 Dg)	0.74	0.42	0.37	0.34	0.32	0.24
n	2	8	15	20	30	59
Da	60.00	15.00	8.00	6.00	4.00	2.03
Dmedian	18.84	3.02	3.02	3.02	3.02	1.00
Dg	18.84	6.29	4.41	4.25	2.98	1.70
S(Log10 Dg)	1.12	0.53	0.46	0.36	0.34	0.26
n		5	12	25	37	64
Da	0.00	15.00	8.00	6.00	4.00	2.03
Dmedian		30.90	3.02	3.02	3.02	1.00
Dg		14.39	4.31	3.68	2.60	1.55
S(Log10 Dg)		0.59	0.57	0.33	0.29	0.23

Table A5-4 Distance between hydraulic features with T > 10^{-11}, T > 10^{-10}, T >10^{-9}, T >10^{-8}, T > 10^{-7} and T > 10^{-6} m^2/s respectively. Data set 4.

DATASET 4

	LogT>-6	LogT>-7	LogT>-8	LogT>-9	LogT>-10	LogT>-11
n	11	40	80	117	175	377
Da	63.73	17.52	8.76	5.99	4.01	1.86
Dmedian	10.23	3.02	3.02	3.02	3.02	1.00
Dg	14.67	6.09	3.25	3.08	2.44	1.42
S(Log10 Dg)	0.91	0.62	0.54	0.45	0.39	0.26
n	2	2	10	23	52	172
Da	163.79	163.79	32.76	14.24	6.30	1.90
Dmedian	56.89	56.89	3.51	4.07	2.00	1.00
Dg	56.89	56.89	7.85	5.94	3.01	1.29
S(Log10 Dg)	1.05	1.05	0.74	0.61	0.51	0.28
n	7	25	43	50	56	78
Da	19.07	5.34	3.11	2.67	2.38	1.71
Dmedian	3.98	3.02	1.00	1.00	1.00	1.00
Dg	7.01	3.42	2.03	1.90	1.75	1.43
S(Log10 Dg)	0.75	0.42	0.37	0.34	0.32	0.24
n	2	8	15	20	30	59
Da	60.00	15.00	8.00	6.00	4.00	2.03
Dmedian	18.84	4.27	3.02	3.02	3.02	1.00
Dg	18.84	6.84	4.58	4.21	2.91	1.70
S(Log10 Dg)	1.12	0.51	0.45	0.36	0.34	0.26
n		5	12	25	37	64
Da	0.00	24.00	10.00	4.80	3.24	1.88
Dmedian		12.88	3.02	3.02	3.02	1.00
Dg		12.13	4.06	3.64	2.57	1.55
S(Log10 Dg)		0.60	0.55	0.33	0.29	0.23

Table A5-5 Distance between hydraulic features with $T > 10^{-11}$, $T > 10^{-10}$, $T > 10^{-9}$, $T > 10^{-8}$, $T > 10^{-7}$ and $T > 10^{-6}$ m^2/s respectively. Data set 5.

DATASET 5

	LogT>-6	LogT>-7	LogT>-8	LogT>-9	LogT>-10	LogT>-11
n	11	40	80	117	175	377
Da	63.73	17.52	8.76	5.99	4.01	1.86
Dmedian	10.23	3.02	3.02	3.02	3.02	1.00
Dg	14.88	5.82	3.21	3.16	2.42	1.42
S(Log10 Dg)	0.91	0.62	0.53	0.45	0.39	0.26
n	2	2	10	23	52	172
Da	163.79	163.79	32.76	14.24	6.30	1.90
Dmedian	56.89	56.89	3.51	3.72	2.00	1.00
Dg	56.89	56.89	7.38	5.52	2.93	1.28
S(Log10 Dg)	1.05	1.05	0.70	0.60	0.51	0.27
n	7	25	43	50	56	78
Da	19.07	5.34	3.11	2.67	2.38	1.71
Dmedian	3.98	3.02	1.00	1.00	1.00	1.00
Dg	7.01	3.42	2.03	1.90	1.75	1.43
S(Log10 Dg)	0.75	0.42	0.37	0.34	0.32	0.24
n	2	8	15	20	30	59
Da	60.00	15.00	8.00	6.00	4.00	2.03
Dmedian	18.84	4.27	3.02	3.02	3.02	1.00
Dg	18.84	6.84	4.58	4.21	2.91	1.70
S(Log10 Dg)	1.12	0.51	0.45	0.36	0.34	0.26
n		5	12	25	37	64
Da	0.00	24.00	10.00	4.80	3.24	1.88
Dmedian		7.08	3.02	3.02	3.02	1.00
Dg		11.80	3.94	3.65	2.58	1.55
S(Log10 Dg)		0.63	0.56	0.33	0.29	0.23

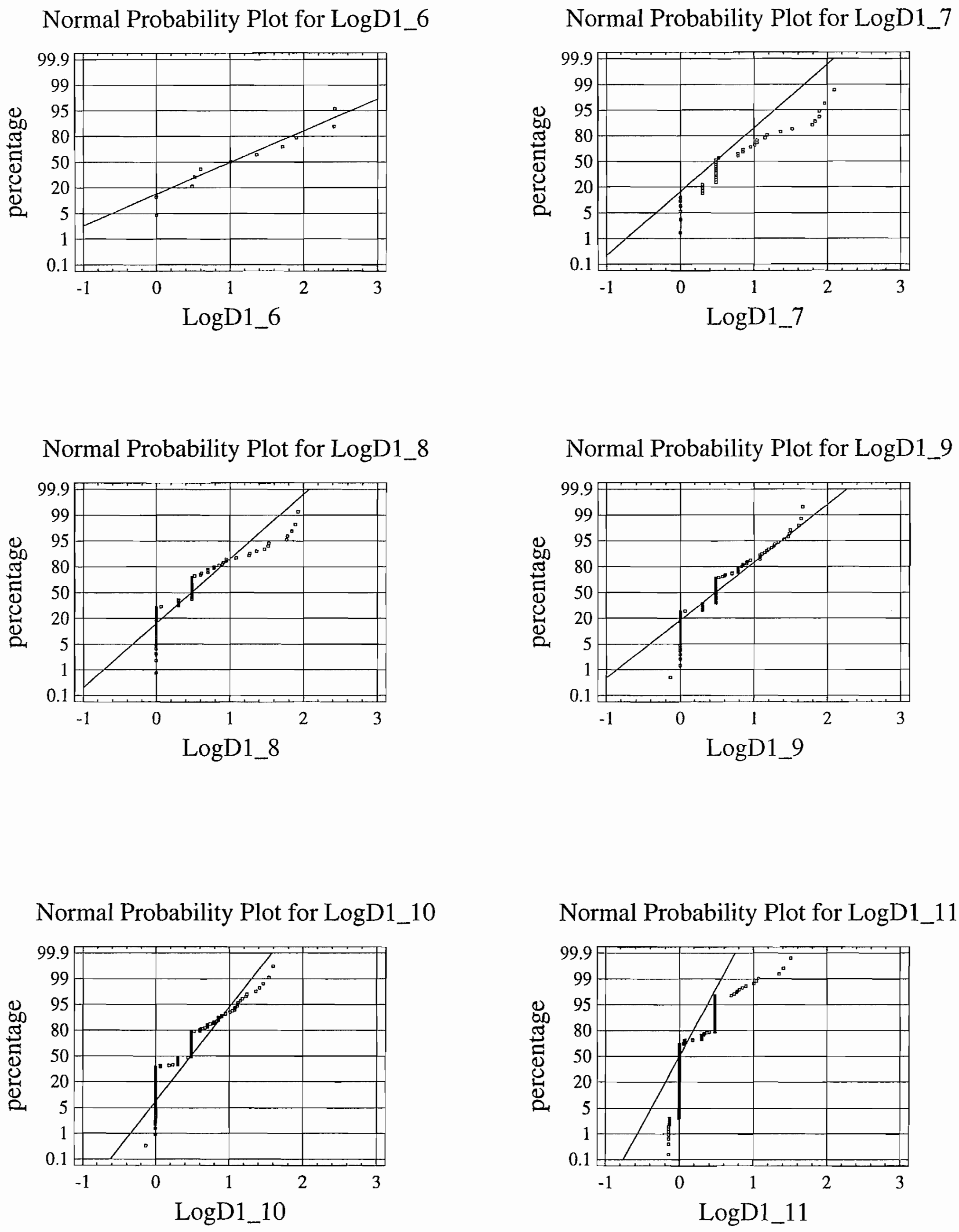


Figure A5-1 Normal probability plot of feature distances of all boreholes

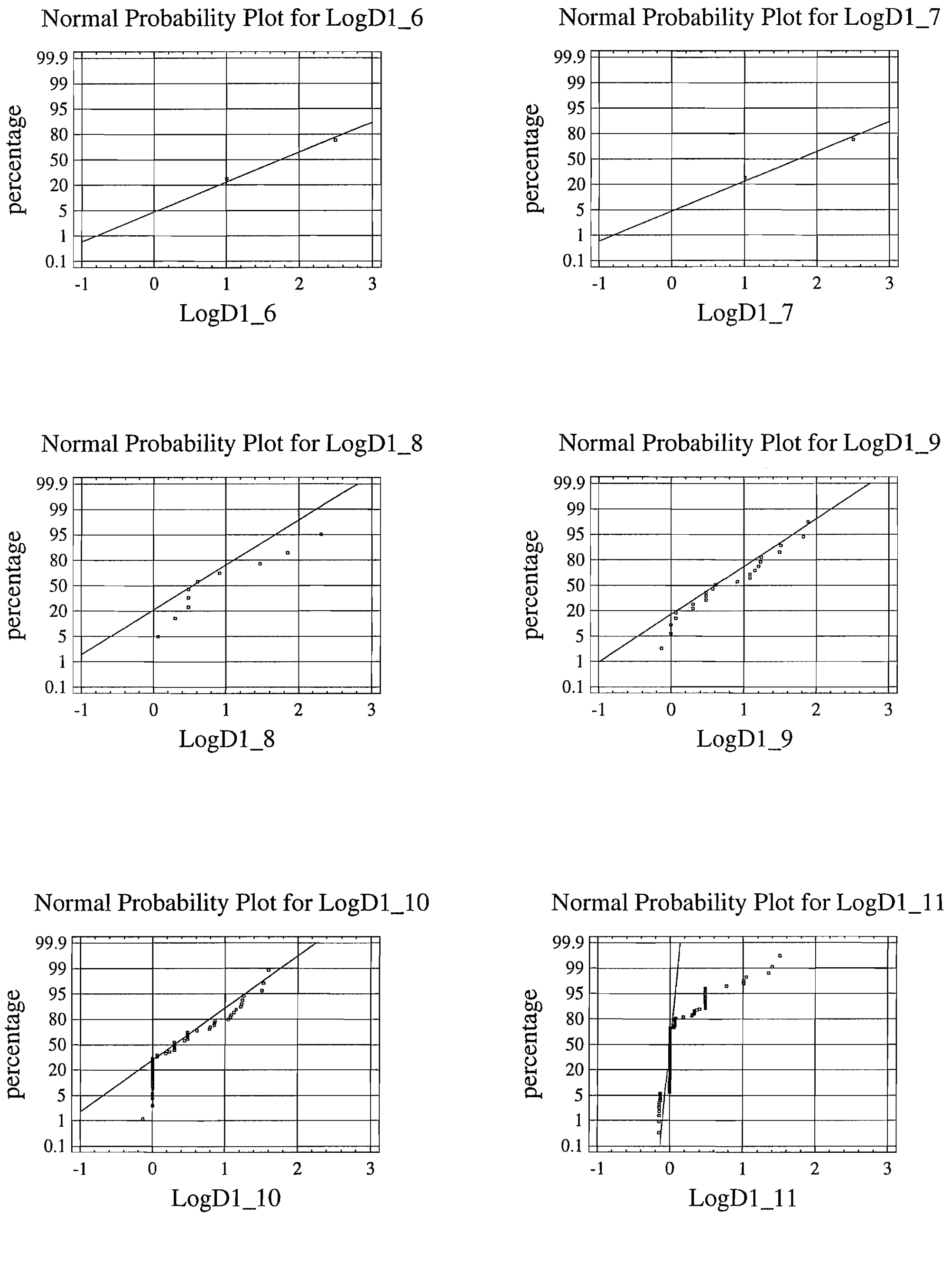


Figure A5-2 Normal probability plots of feature distances of subvertical boreholes

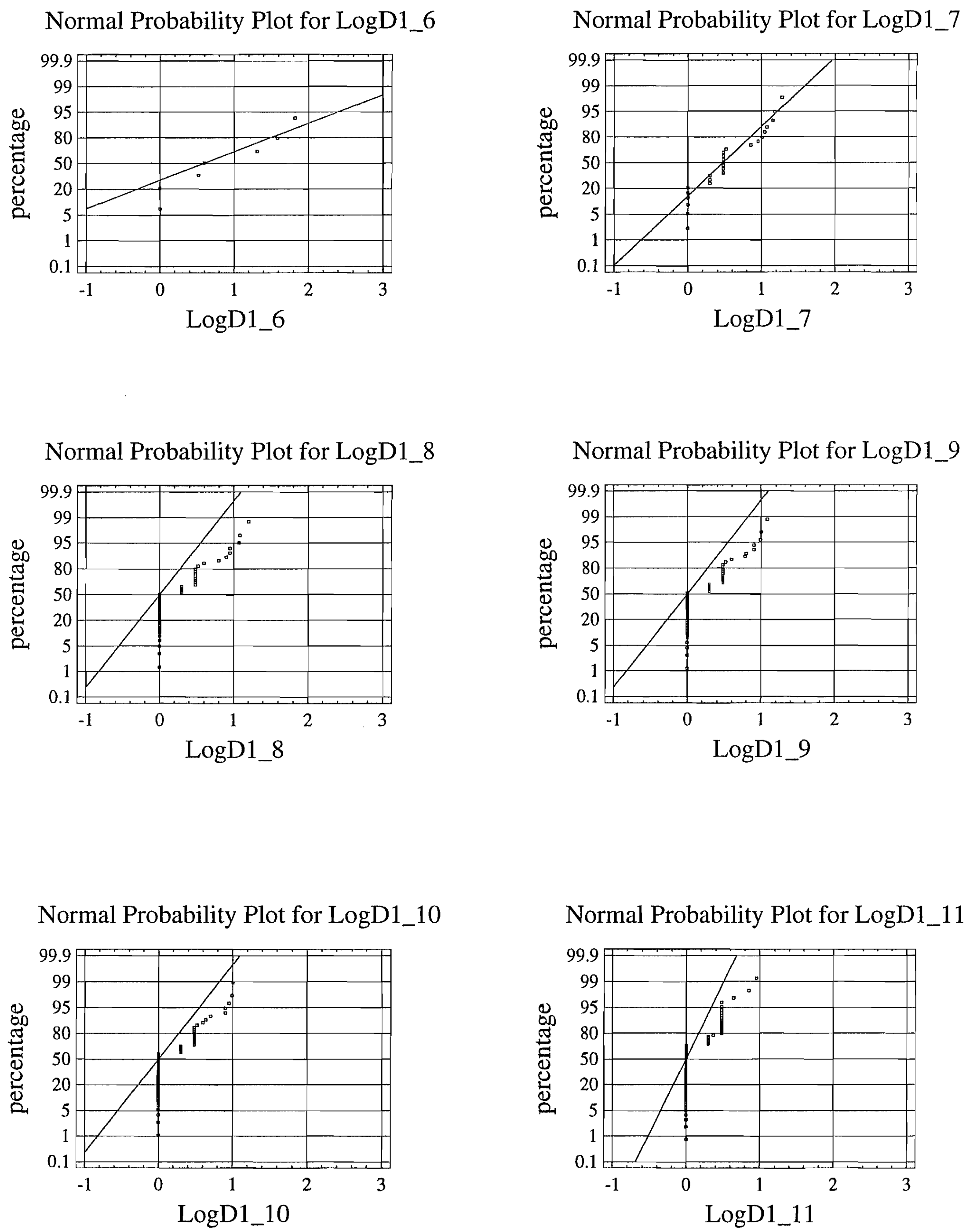
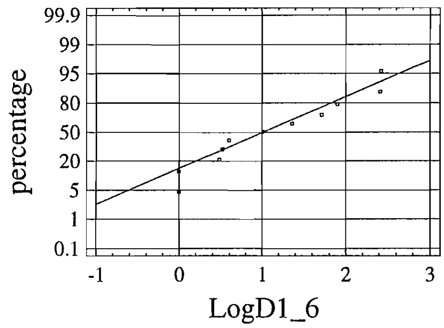
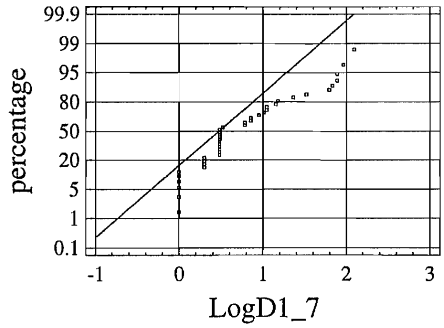


Figure A5-3 Normal probability plots of feature distances sub horizontal boreholes

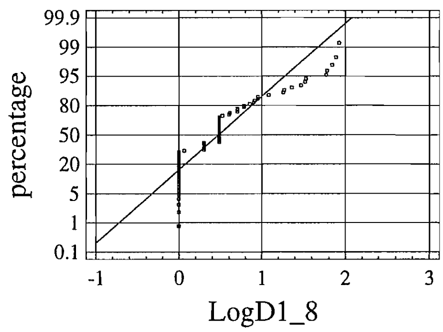
Normal Probability Plot for LogD1_6



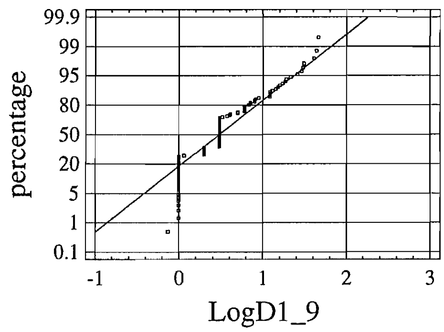
Normal Probability Plot for LogD1_7



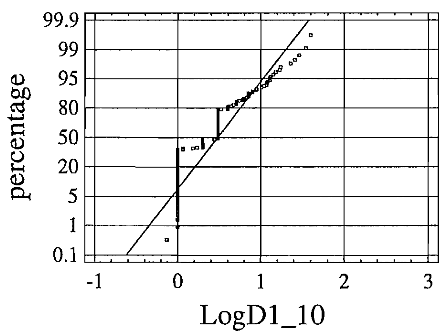
Normal Probability Plot for LogD1_8



Normal Probability Plot for LogD1_9



Normal Probability Plot for LogD1_10



Normal Probability Plot for LogD1_11

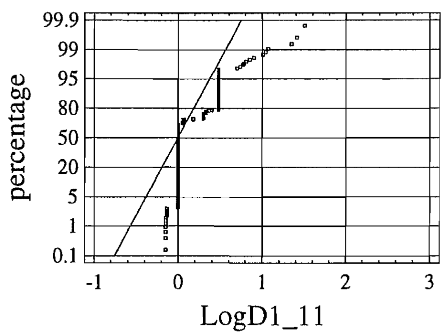


Figure A5-4 Normal probability plots of feature distances of southern boreholes

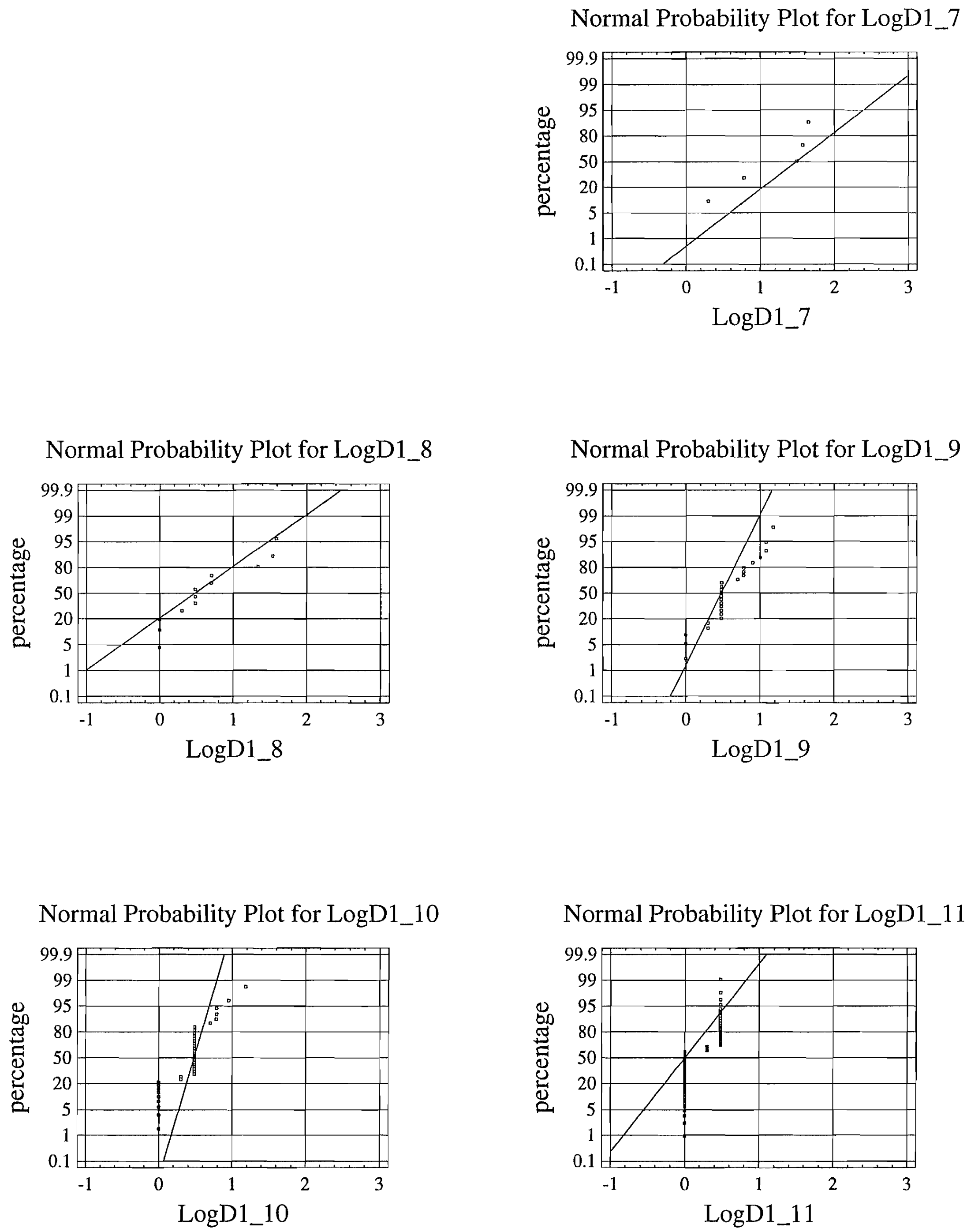
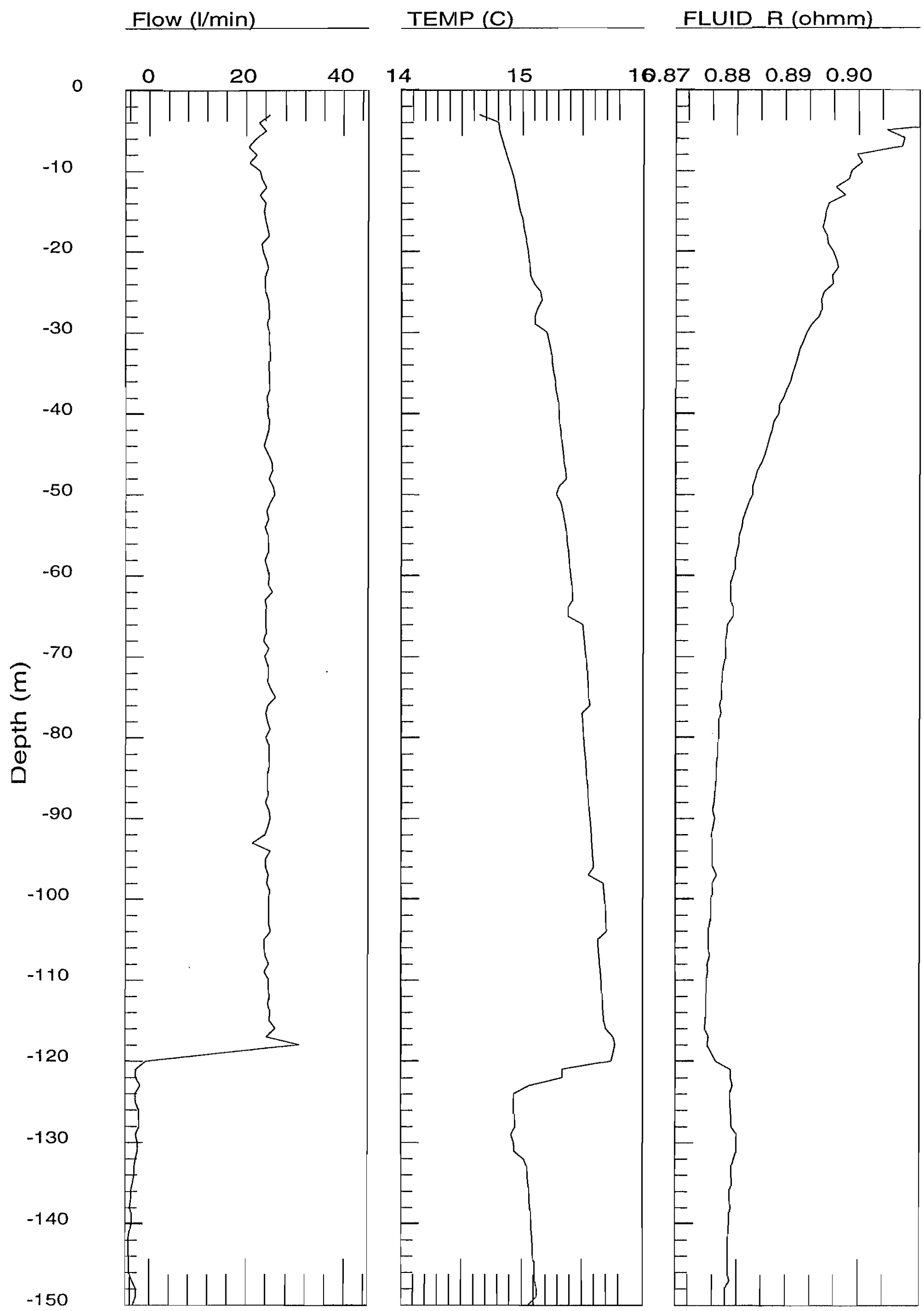


Figure A5-5 Normal probability plots of feature distances of northern boreholes

APPENDIX 6

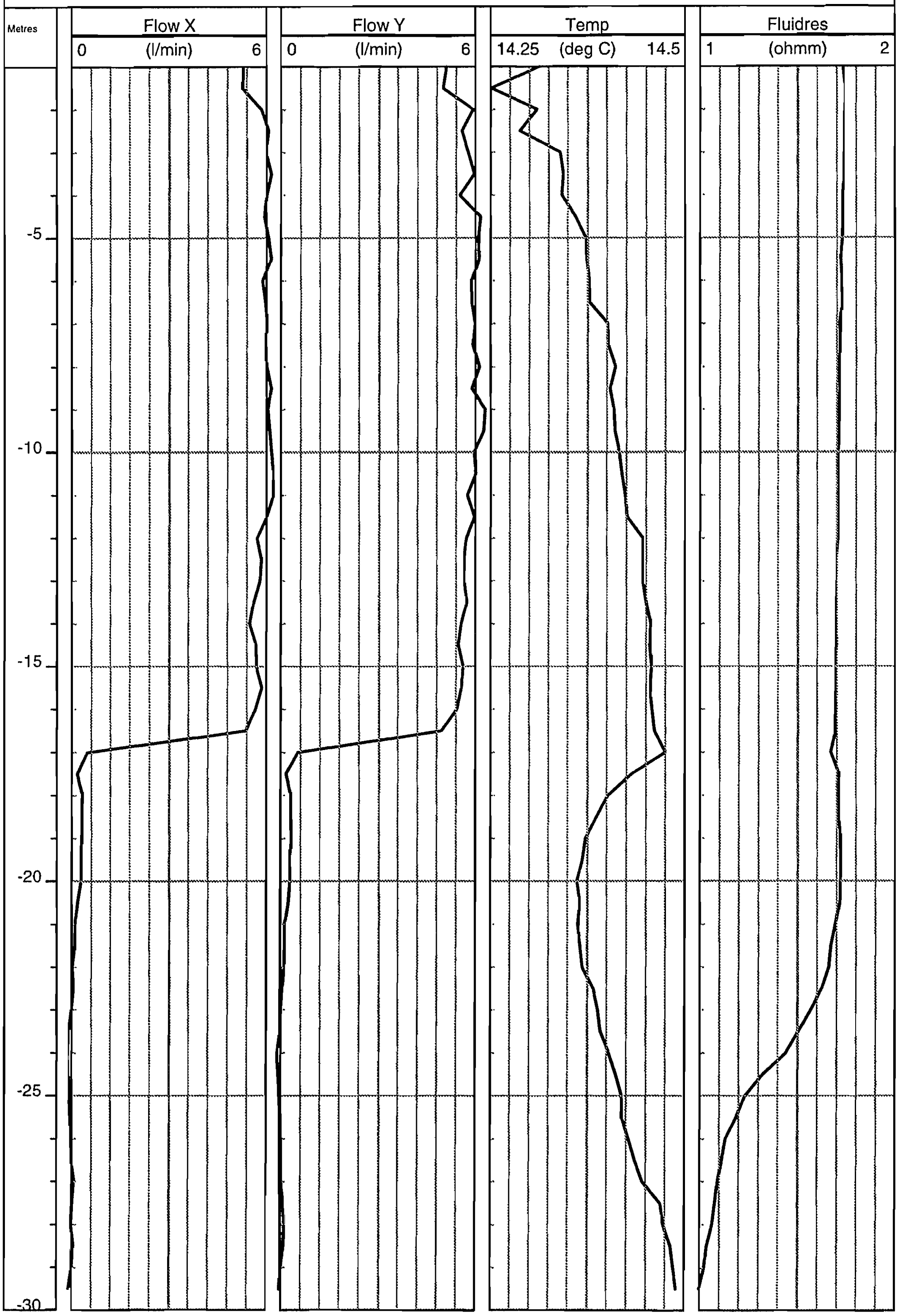
Flow logging with UCM - logger

Well Name: KA3510A
File Name: C:\VLW\LOGG\KA3510A.HDR
Location: ASPO HRL
Elevation: 0 Reference: Rock Surface



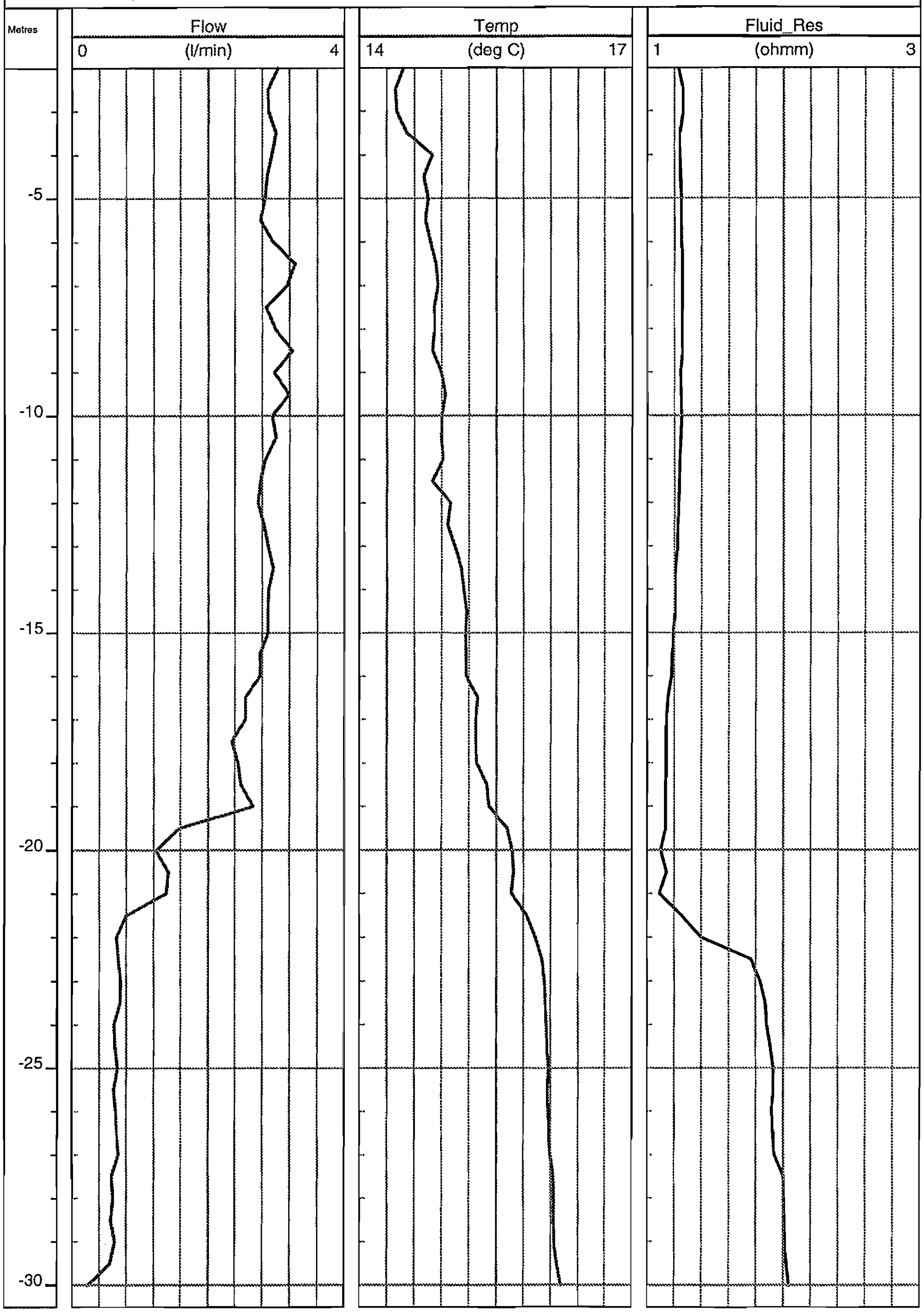
Well Name: KA3539G
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-05-21
Probe id: 9302, probe centralized and with a outside diameter of 75mm.



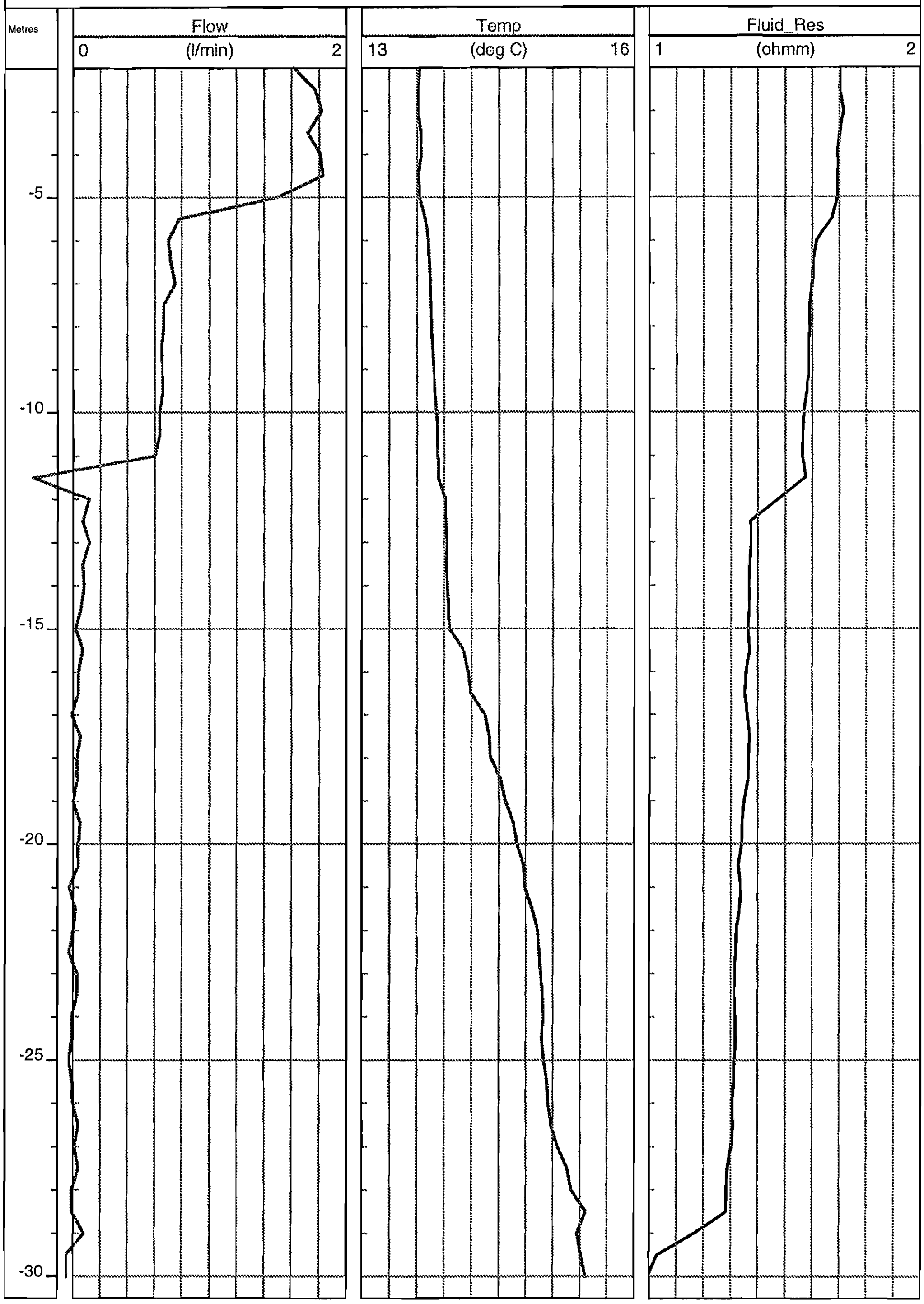
Well Name: KA3542G01
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-07-07, 17:54-18:44
Probe id: 9302, probe centralized and with a outside diameter of 75 mm



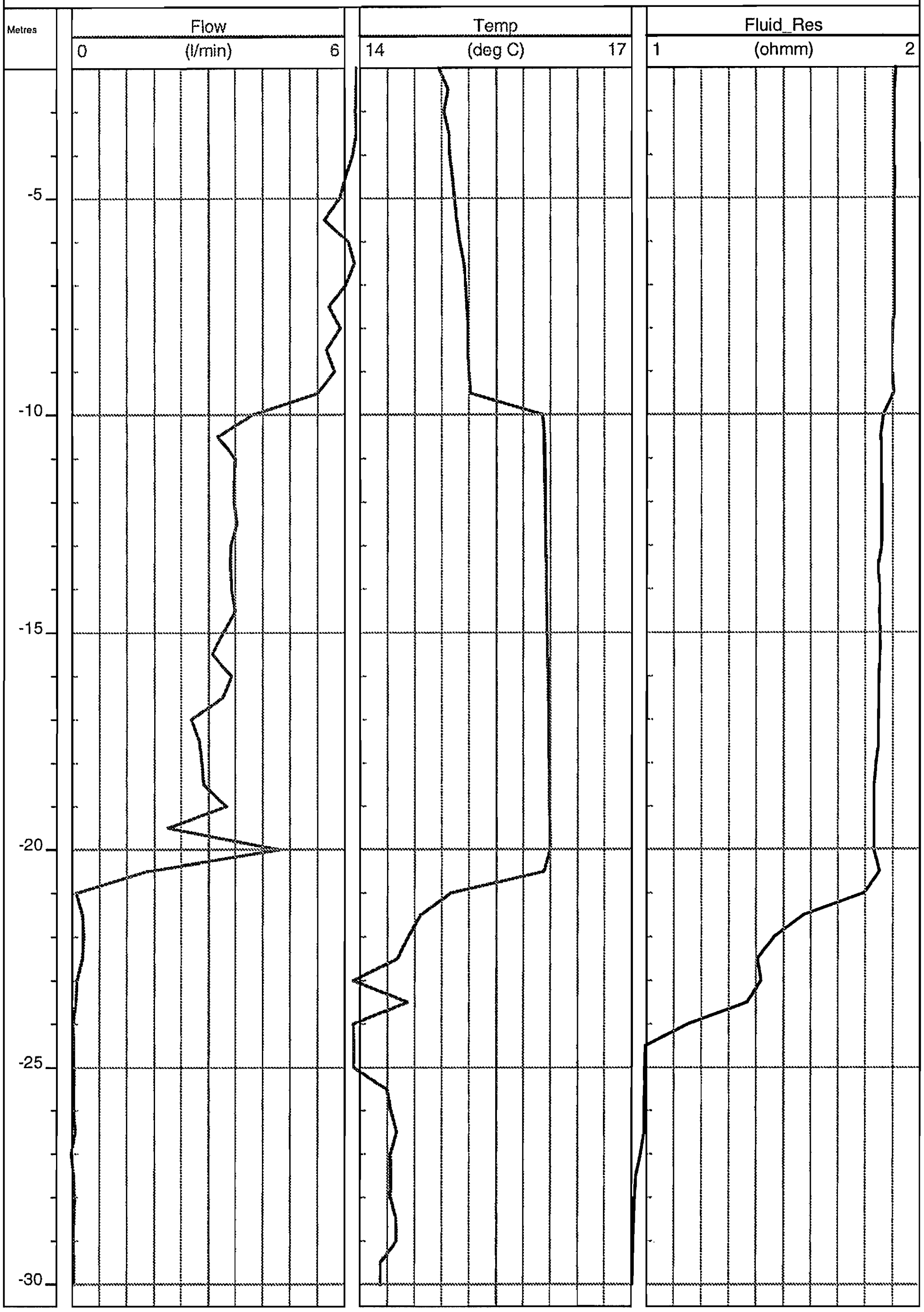
Well Name: KA3542G02
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-07-07, 18:53-19:37
Probe id: 9302, probe centralized and with outside diameter of 75 mm



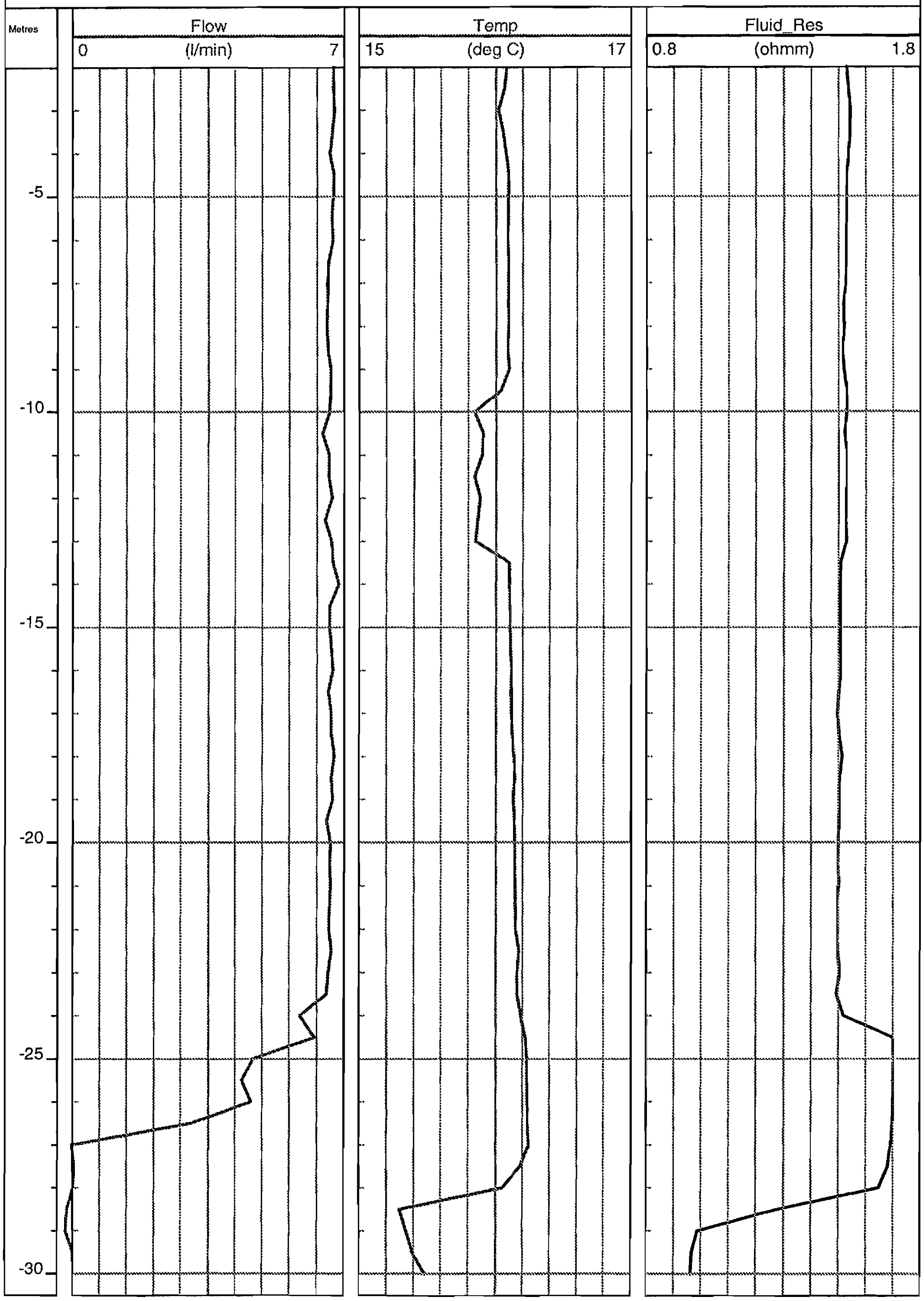
Well Name: KA3548A01
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-07-08, 08:40-09:30
Probe id: 9302, probe centralized and with a outside diameter of 75 mm



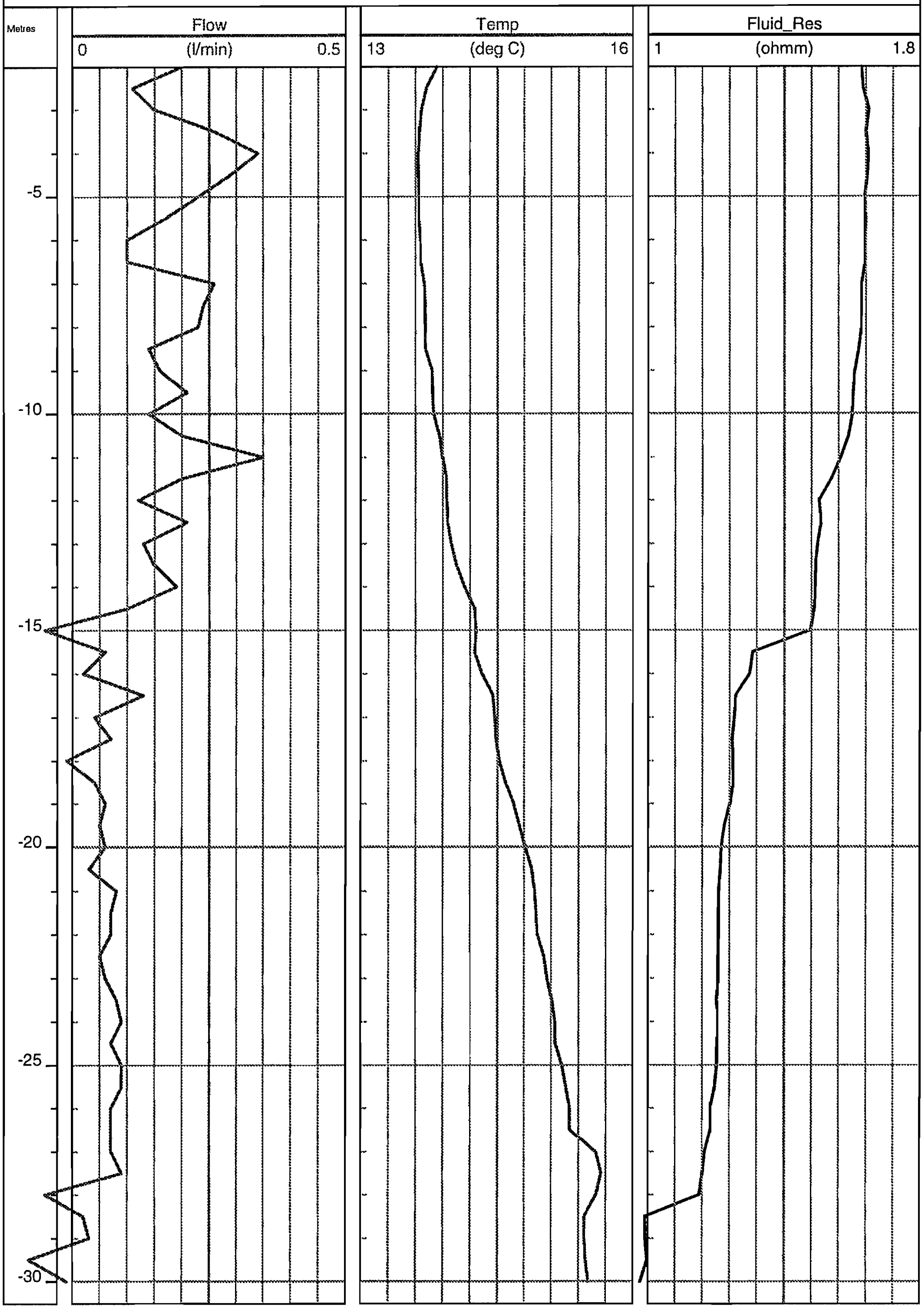
Well Name: KA3554G01
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-07-08, 10:01-10:49
Probe id: 9302, probe centralized and with a outside diameter of 75 mm



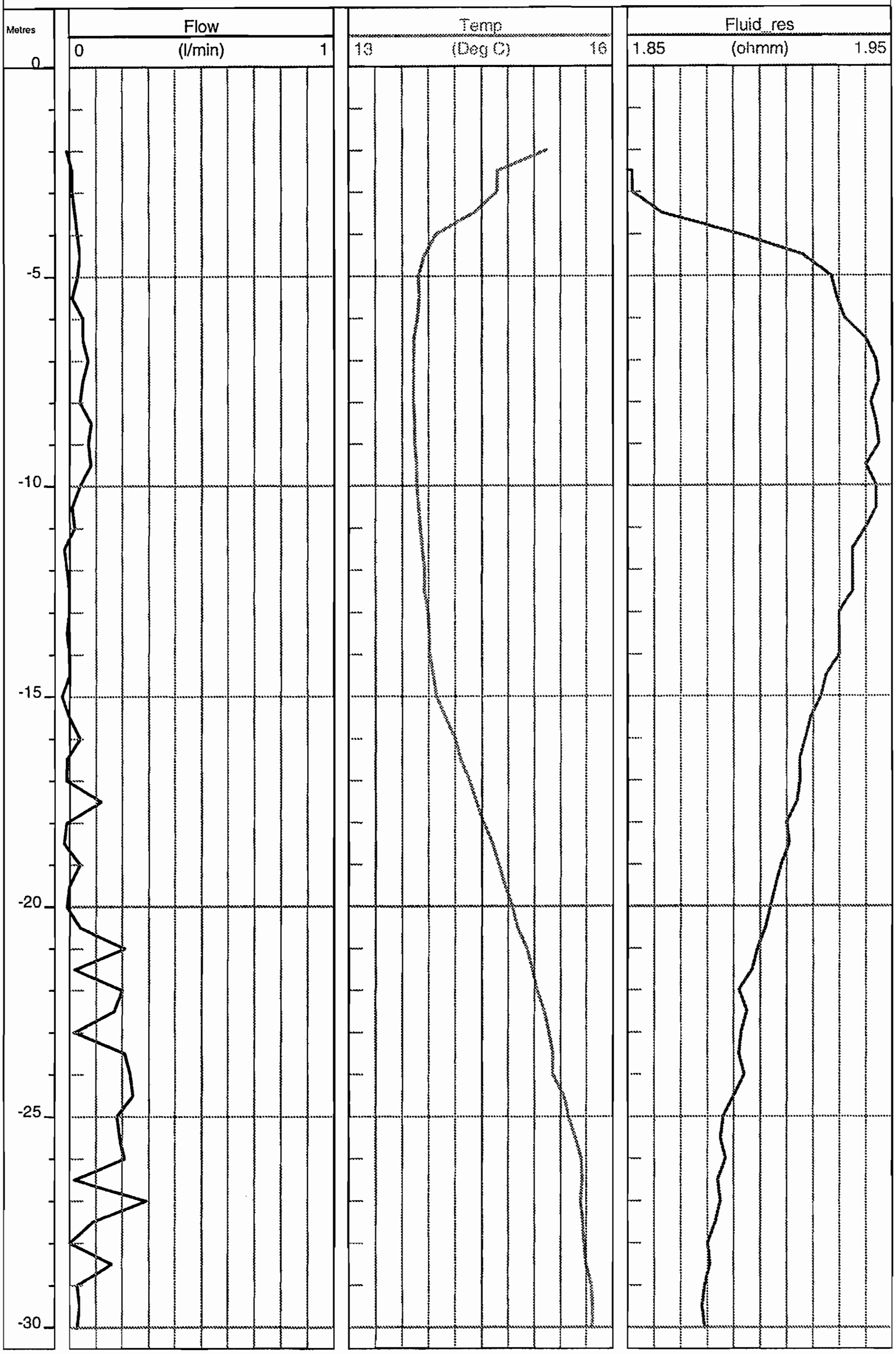
Well Name: KA3554G02
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-07-08, 10:56-11:45
Probe id: 9302, probe centralized and with a outside diameter of 75 mm



Well Name: KA3557G
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 98-09-03 Logging Company: MALA GeoScience
Probe id: UCM 9302

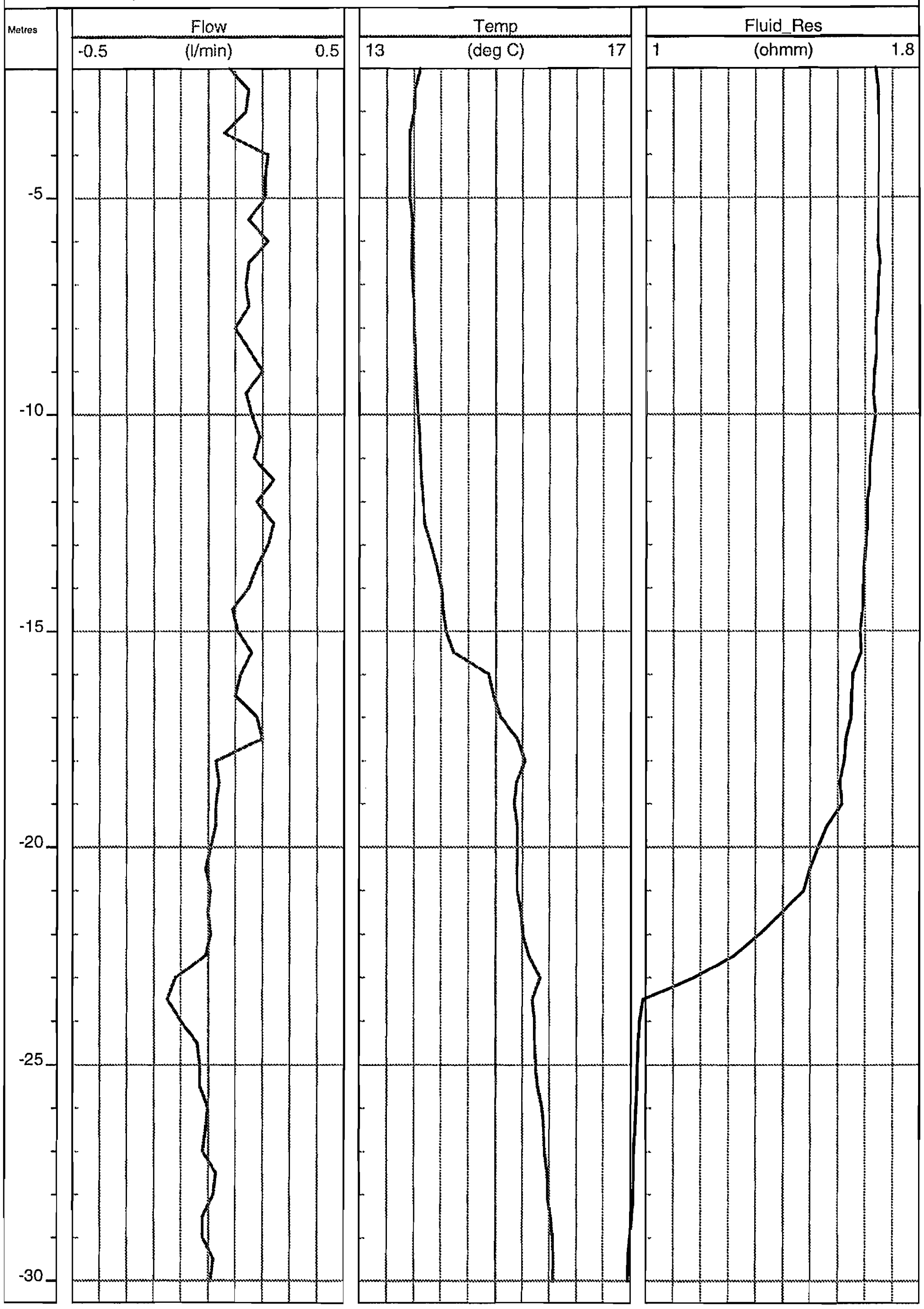


Well Name: KA3563G
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 98-09-04 Logging Company: MALA GeoScience
Probe id: UCM9302

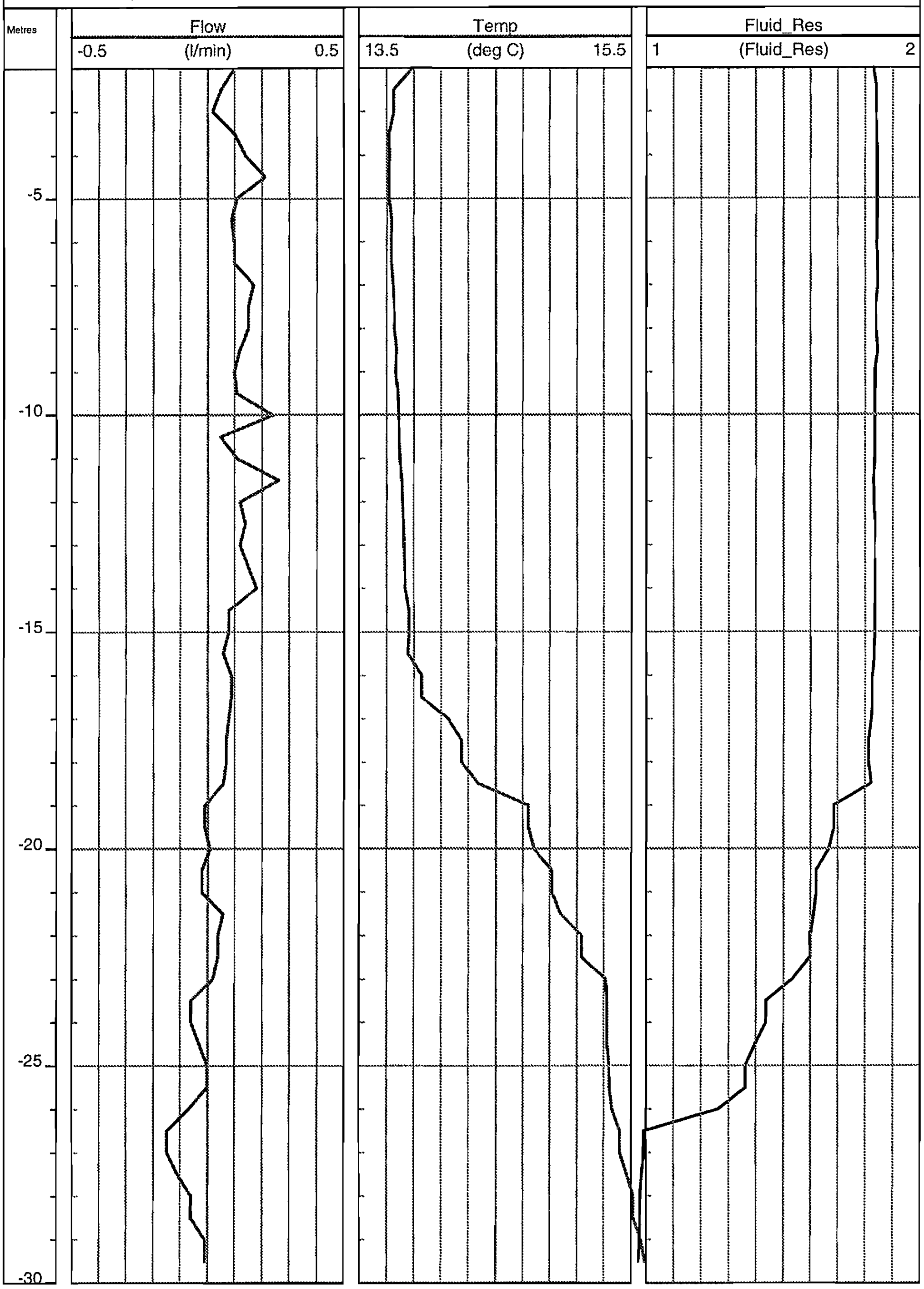
Well Name: KA3566G01
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-07-08, 13:26-14:17
Probe Id: 9302, probe centralized and with a outside diameter of 75 mm



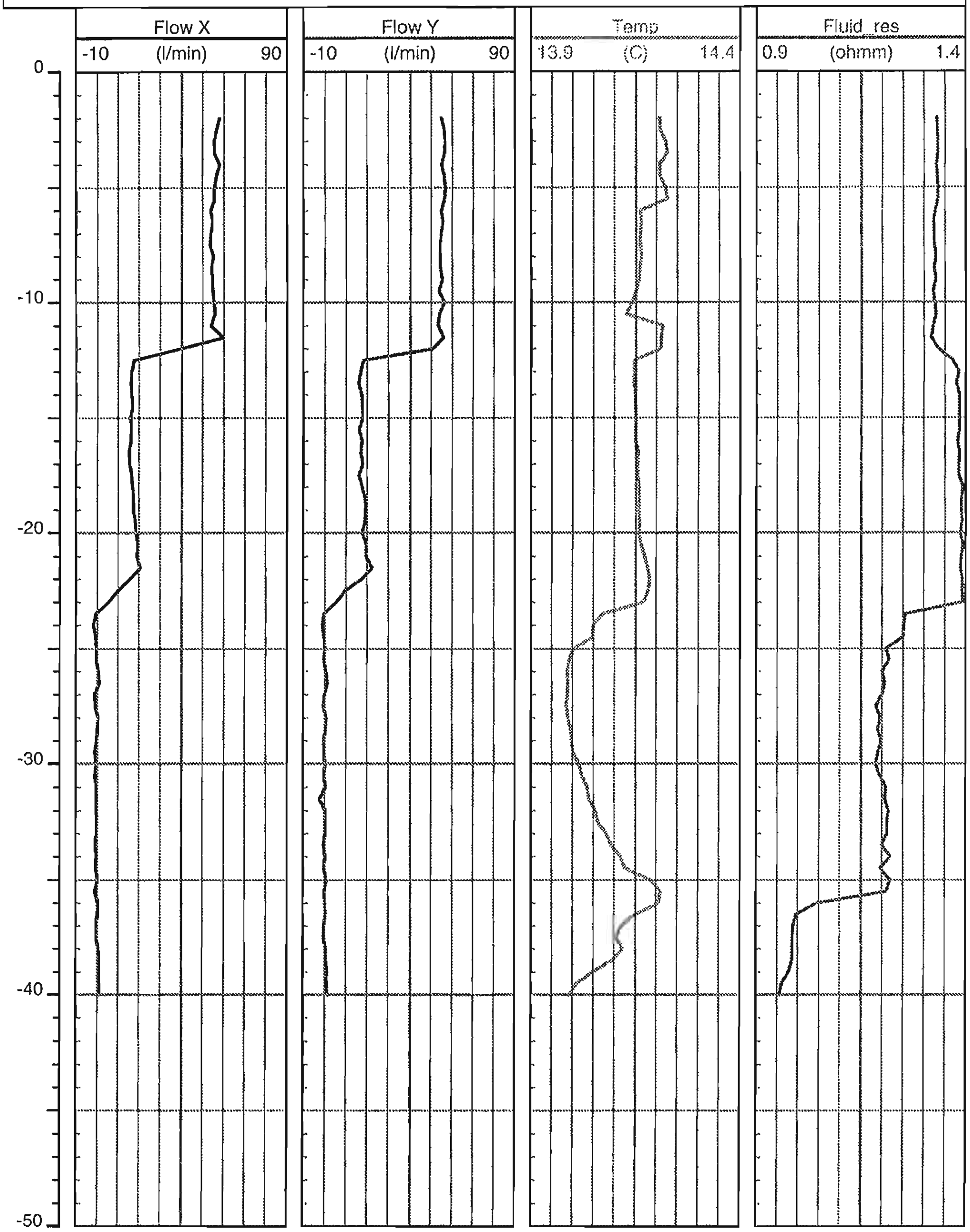
Well Name: KA3566G02
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-07-08, 14:28-15:03
Probe id: 9302, probe centralized and with a diameter of 75 mm



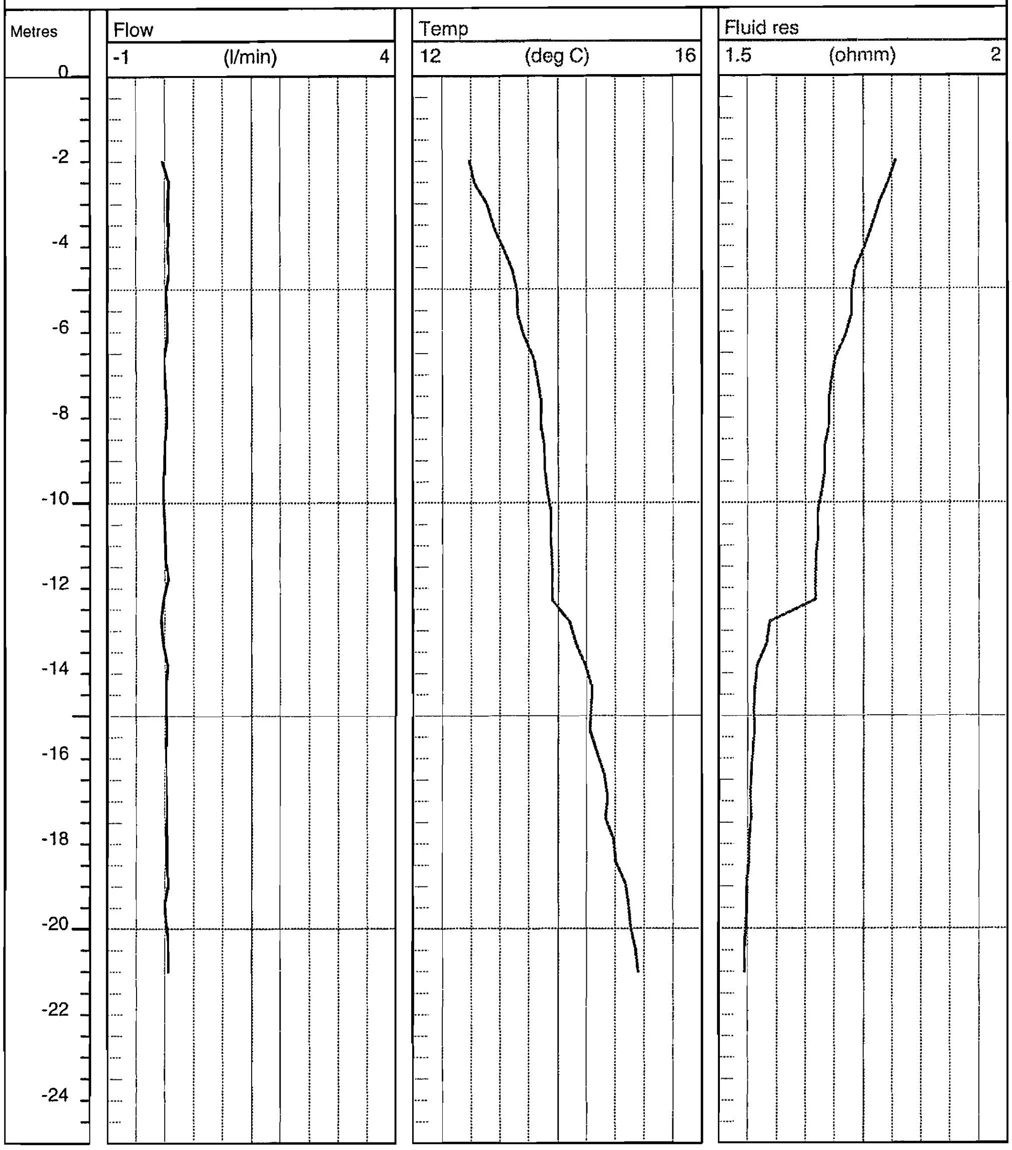
Well Name: KA3573A
Location: ASPO HRL,
Elevation: 0 Reference: RockSurface

Date: 97-11_29
Tool: UCM9302



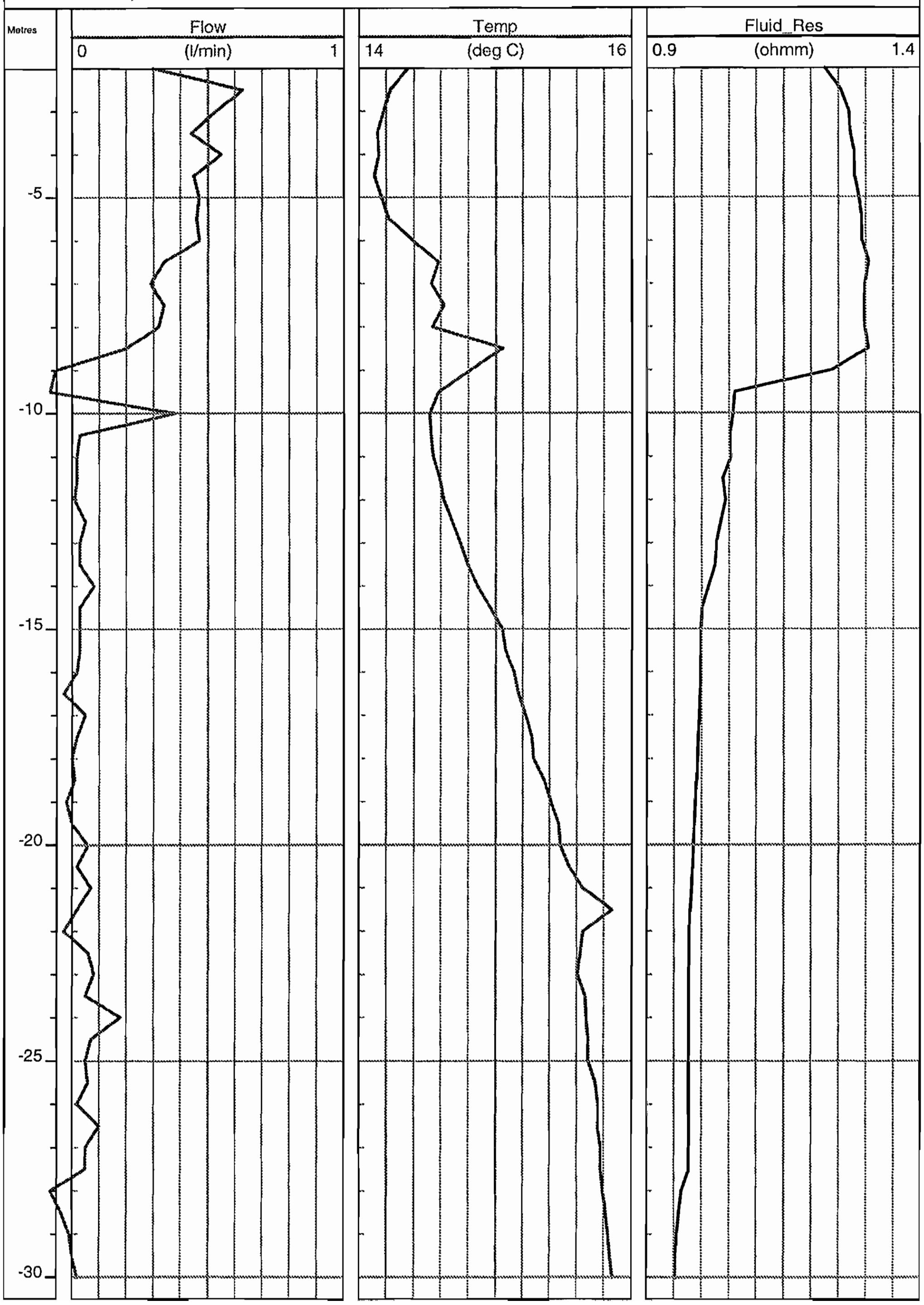
Well Name: KA3579G
Location: ASPO HRL Prototyp
Elevation: 0 Reference: Rock Surface

Performed by: MALA GeoScience
Date: 1999-01-13



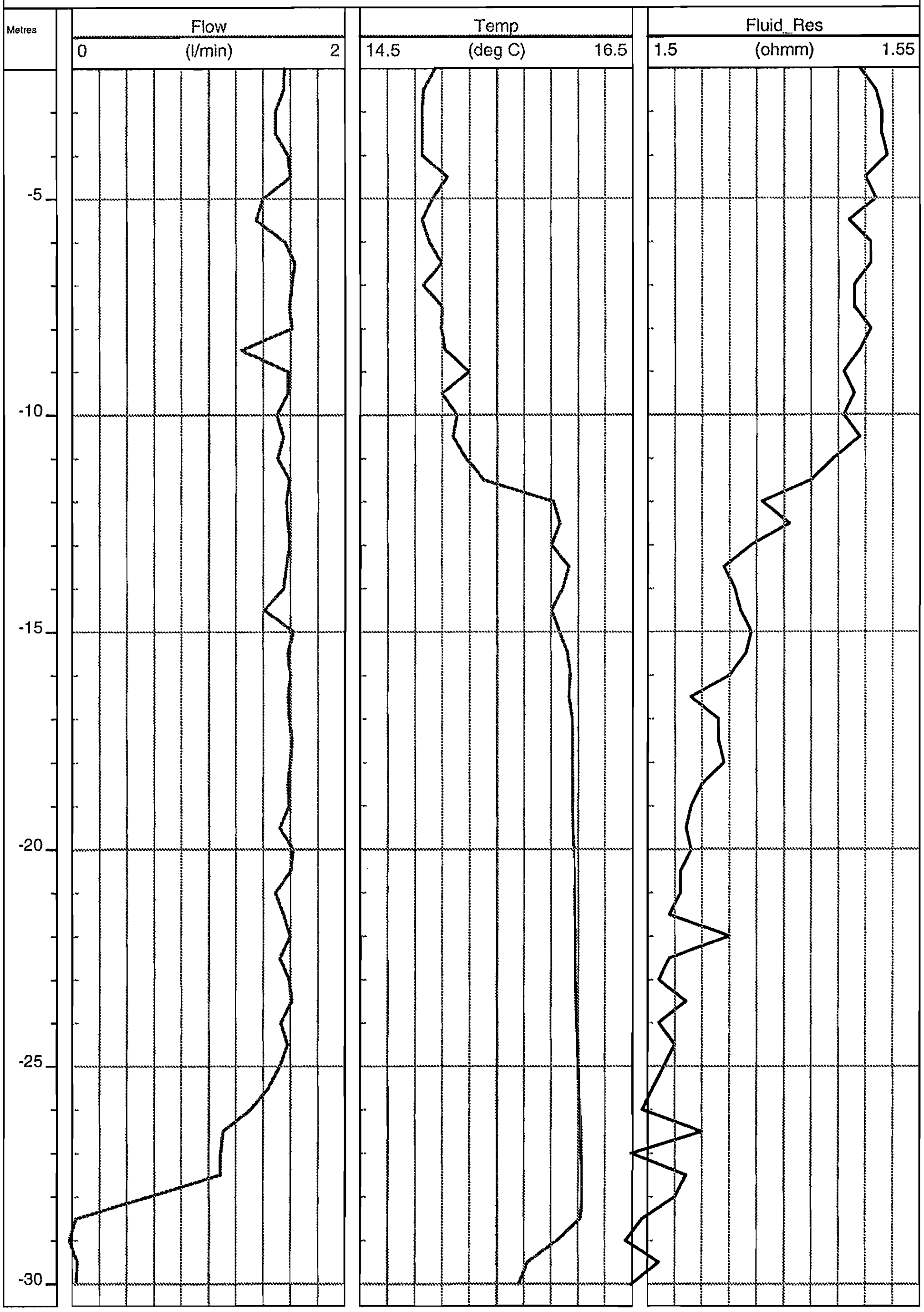
Well Name: KA3590G01
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-07-08, 15:40-16:20
Probe id: 9302, probe centralized and with a outside diameter of 75 mm



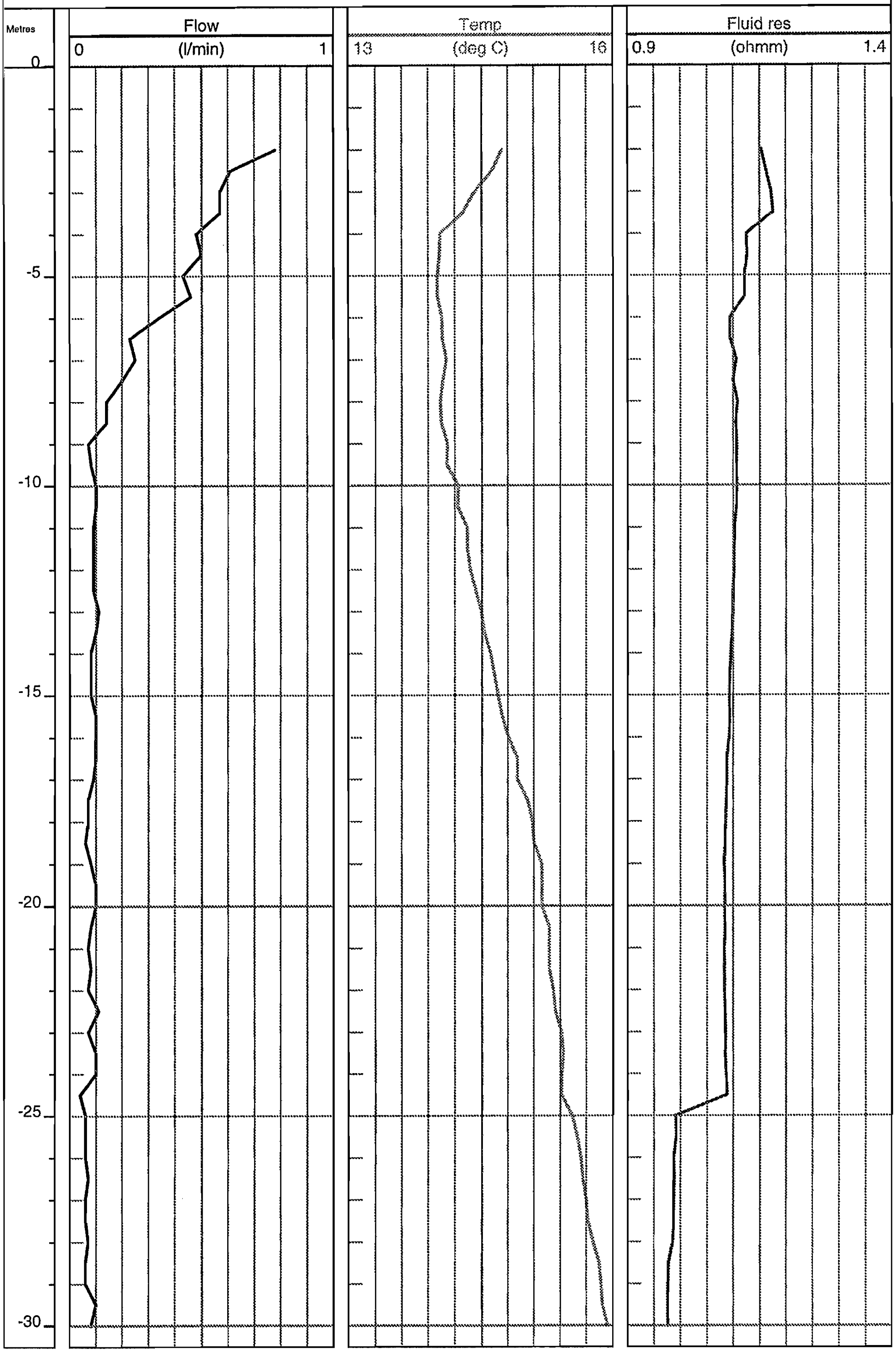
Well Name: KA3590G02
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 1998-07-08, 16:38-17:20
Probe id: 9302, probe centralized and with a outside diameter of 75 mm



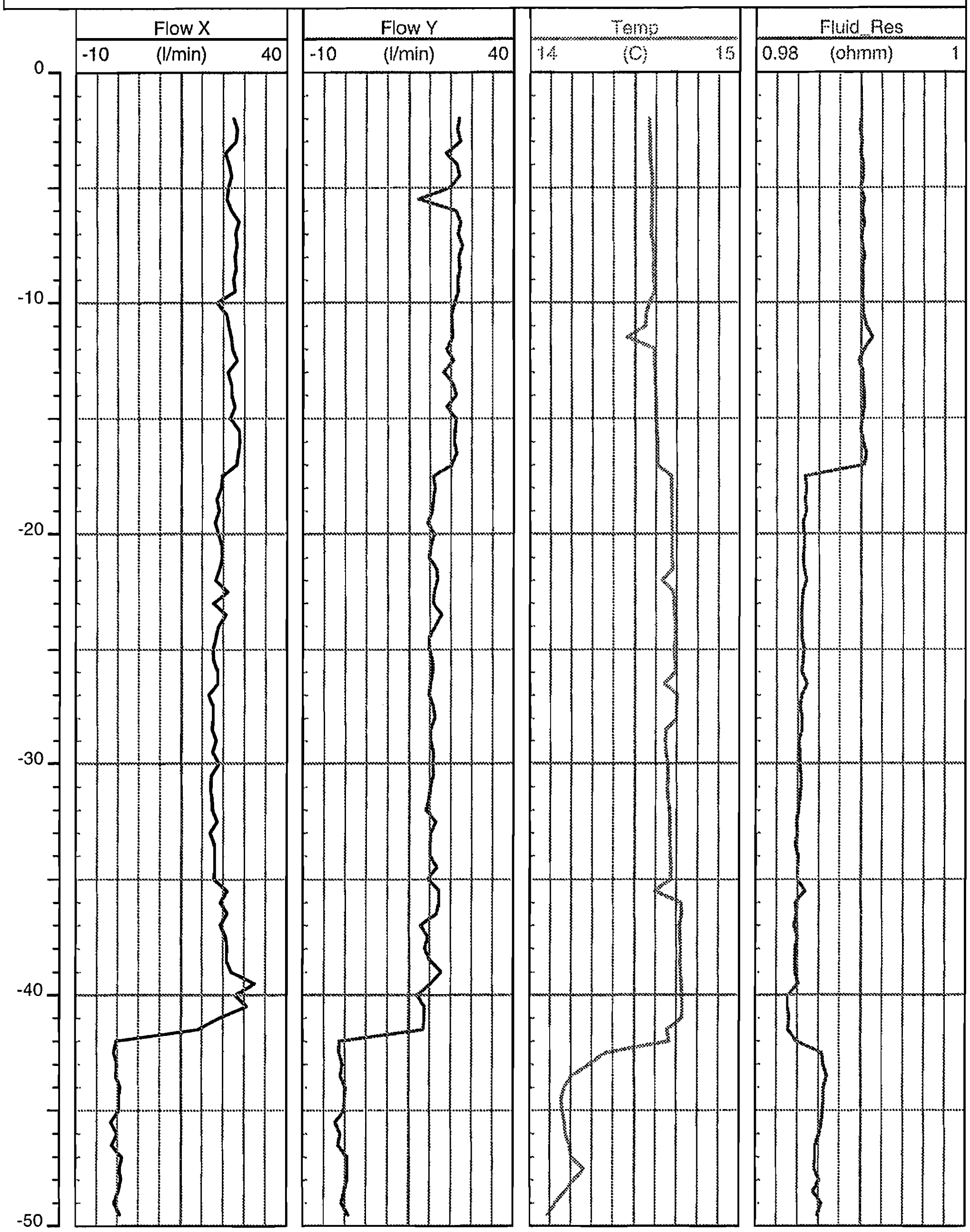
Well Name: KA3593G
Location: ASPO HRL Prototype Repository
Elevation: 0 Reference: Ground Surface

Date: 98-09-04 Logging Company: MALA GeoScience
Probe id: UCM9302



Well Name: KA3600F
Location: ASPO HRL, Prototype Repository Site
Elevation: 0 Reference: Rock Surface

Date: 97-11-29
Tool: UCM93002



APPENDIX 7

Level of flow outlet during pressure build-up tests and interference tests during test campaigns 1, 2, 3a and 3b.

Table Outflow level above the floor.
Tests in pilot holes and exploratory holes, November 1997 - July 1999.

Borehole	Section (m)	Date	Test Cam-paign	Test No	Test type	Outflow level above floor (m)	Comment
KA3593G	0.70-8.04	971105	1	1	I	1.40	
KA3587G	0.70-8.04	971106	1	2	PBT	1.40	
KA3581G	0.70-8.04	971106	1	3	PBT	1.40	
KA3575G	0.70-8.04	971106	1	4	PBT	1.40	
KA3569G	0.70-8.04	971106	1	5	PBT	1.40	
KA3563G	0.70-8.04	971106	1	6	PBT	1.40	
KA3557G	0.70-8.04	971106	1	7	PBT	1.40	
KA3551G	0.70-8.04	971106	1	8	PBT	1.40	
KA3545G	0.70-8.04	971107	1	9	I	1.40	
KA3539G	0.70-8.04	971107	1	10	I	1.40	
KA3539G	5.74-6.74	971108	1	11	PBT	0.85	
KA3539G	6.74-8.04	971109	1	12	PBT	0.85	
KA3545G	5.74-6.74	971109	1	13	PBT	0.85	
KA3545G	6.74-8.04	971110	1	14	PBT	0.85	
KA3593G	4.74-5.74	971118	1	15	PBT	0.85	
KA3588G01	0.50-8.00	980401	2	1	I	1.60	
KA3586G01	0.50-8.00	980401	2	2	PBT	1.60	
KA3572G01	0.50-12.00	980402	2	3	PBT	1.60	
KA3552G01	0.50-12.01	980402	2	4	I	1.60	
KA3550G01	0.50-12.03	980403	2	5	I	1.60	
KA3544G01	0.50-12.00	980403	2	6	I	1.60	
KA3548G01	0.50-12.01	980403	2	7	I	1.60	
KA3546G01	0.50-12.00	980404	2	8	I	1.60	
KA3578G01	0.50-12.58	980404	2	9	PBT	1.60	
KA3584G01	1.21-12.00	980405	2	10	PBT	0.89	
KA3544G01	9.70-10.70	980407	2	11	PBT	0.93	
KA3548G01	5.70- 6.70	980414	2	12	PBT	0.93	
KA3550G01	5.70- 6.70	980415	2	13	PBT	0.97	
KA3552G01	4.70- 5.70	980416	2	14	PBT	0.97	
KA3588G01	4.70- 5.70	980421	2	15	PBT	0.75	
KA3590G02	12.0 – 15.0	980625	3a	1	PBT	0,90	
KA3590G02	18.0 – 21.0	980625	3a	2	PBT	0.93	
KA3590G02	24.0 – 27.0	980625	3a	3	PBT	0.93	
KA3590G02	27.0 – 30.0	980626	3a	4	PBT	0.93	
KA3590G02	0.39 – 30.0	980701	3a	5	I	1.02	
KA3590G01	0.39 – 30.0	980701	3a	6	I	1.03	
KA3593G	0.39 – 30.0	980701	3a	7	I	1,55	
KA3566G02	0.39 – 30.0	980701	3a	8	I	1.02	
KA3566G01	0.39 – 30.0	980702	3a	9	I	0.98	
KA3554G01	0.39 – 30.0	980702	3a	10	I	0.96	
KA3554G02	0.39 – 30.0	980702	3a	11	I	1.01	
KA3542G02	0.39 – 30.0	980703	3a	12	I	1.01	
KA3542G01	0.39 – 30.0	980703	3a	13	I	1.01	
KA3539G	0.39 – 30.0	980703	3a	14	I	1.55	
KA3557G	0.39 – 30.0	980704	3a	15	PBT	1.57	
KA3574G01	0.39-12.0	980704	3a	16	PBT	1.55	
KA3576G01	0.39-12.0	980705	3a	17	PBT	1.55	
KA3548A01	0.39–30.00	980705	3a	18	I		The borehole is positioned c. 2.45 m above floor

Borehole	Section (m)	Date	Test Cam-paign	Test No	Test type	Outflow level above floor (m)	Comment
KA3563G	0.39–30.00	980706	3a	19	PBT	1.55	
KA3590G01	1.0 – 2.0	980706	3a	20	PBT	0.93	
KA3590G01	2.0 – 3.0	980706	3a	21	PBT	0.90	
KA3590G01	5.0 – 6.0	980707	3a	22	PBT	0.90	
KA3590G01	8.0 – 9.0	980707	3a	23	PBT	0.93	
KA3590G01	9.0 – 10.0	980708	3a	24	PBT	0.93	
KA3593G	11.0 – 12.0	980708	3a	25	PBT	0.93	
KA3590G01	21.0 – 24.0	980709	3a	26	PBT	0.93	
KA3566G01	13.0 – 16.0	980714	3a	27	PBT	0.90	
KA3566G01	16.0 – 19.0	980714	3a	28	PBT	0.86	
KA3566G01	19.0 – 22.0	980714	3a	29	PBT	0.86	
KA3566G02	15.0 – 18.0	980716	3a	30	PBT	0,87	
KA3566G02	18.0 – 21.0	980716	3a	31	PBT	0,86	
KA3566G02	21.0 – 24.0	980716	3a	32	PBT	0,86	
KA3554G02	8.0 – 9.0	980720	3a	33	PBT	0,86	
KA3554G02	11.0 – 12.0	980720	3a	34	PBT	0,86	
KA3554G02	12.0 – 15.0	980721	3a	35	PBT	0,86	
KA3554G02	15.0 – 18.0	980721	3a	36	PBT	0,86	
KA3554G02	27.0 – 30.0	980722	3a	37	PBT	0,86	Failed,
KA3554G02	27.0 – 30.0	980724	3a	37b	PBT	0,86	Failed,
KA3554G01	18.0 – 21.0	980723	3a	38	PBT	0,86	
KA3554G01	21.0 – 24.0	980723	3a	39	PBT	0,86	
KA3554G01	24.0 – 27.0	980723	3a	40	PBT	0,79	
KA3554G01	27.0 – 30.0	980724	3a	41	PBT	0,86	
KA3542G02	3.0 – 4.0	980727	3a	42	PBT	0,97	
KA3542G02	5.0 – 6.0	980727	3a	43	PBT	0,97	
KA3542G02	4.0 – 5.0	980727	3a	44	PBT	0,97	
KA3542G02	10.0 – 11.0	980728	3a	45	PBT	0,96	
KA3542G02	11.0 – 12.0	980728	3a	46	PBT	0,96	
KA3542G02	12.0 – 15.0	980728	3a	47	PBT	0,96	
KA3542G02	15.0 – 18.0	980729	3a	48	PBT	0,96	
KA3542G02	18.0 – 21.0	980729	3a	49	PBT	0,96	
KA3542G02	24.0 – 27.0	980729	3a	50	PBT	0,96	
KA3542G01	12.0 – 15.0	980730	3a	51	PBT	0,96	
KA3542G01	15.0 – 18.0	980730	3a	52	PBT	0,96	
KA3542G01	18.0 – 21.0	980731	3a	53	PBT	0,96	
KA3542G01	21.0 – 24.0	980731	3a	54	PBT	0,96	
KA3542G01	27.0 – 30.0	980731	3a	55a	PBT	0,96	Failed,
KA3542G01	27.0 – 30.0	980731	3a	55b	PBT	0,96	Failed
KA3539G	11.0 – 12.0	980801	3a	56	PBT	0,85	
KA3539G	12.0 – 15.0	980801	3a	57	PBT	0,85	
KA3539G	15.0 – 18.0	980801	3a	58	PBT	0,85	
KA3539G	18.0 – 21.0	980802	3a	59	PBT	0,85	
KA3539G	21.0 – 24.0	980802	3a	60	PBT	0,90	
KA3548A01	5.0 – 6.0	980804	3a	61	PBT	2,40	The borehole is positioned c. 2.45 m above floor
KA3548A01	6.0 – 7.0	980805	3a	62	PBT	2,40	xxxx "
KA3548A01	9.0 – 10.0	980805	3a	63	PBT	2,40	xxxx "
KA3548A01	12.0 – 15.0	980806	3a	64	PBT	2,40	xxxx "
KA3548A01	15.0 – 18.0	980806	3a	65	PBT	2,40	xxxx "
KA3548A01	18.0 – 21.0	980807	3a	66	PBT	2,40	xxxx "
KA3548A01	21.0 – 24.0	980807	3a	67	PBT	2,40	xxxx "
KA3548A01	24.0 – 27.0	980808	3a	68	PBT	"	xxxx "
KG0048A01	0.0 – 54.69	981007	3b	1	I	c. 2	
KG0048A01	5.0 – 8.0	981008	3b	2	PBT	c. 2	

Borehole	Section (m)	Date	Test Cam-paign	Test No	Test type	Outflow level above floor (m)	Comment
KG0048A01	17.0 – 20.0	981009	3b	3	PBT	c. 2	
KG0048A01	20.0 – 23.0	981009	3b	4	PBT	c. 2	
KG0048A01	23.0 – 24.0	981009	3b	5	PBT	c. 2	
KG0048A01	24.0 – 25.0	981010	3b	6	PBT	c. 2	
KG0048A01	27.0 – 28.0	981010	3b	7	PBT	c. 2	
KG0048A01	33.0 – 34.0	981011	3b	8	PBT	c. 2	
KG0048A01	41.0 – 42.0	981012	3b	9	PBT	c. 2	
KG0048A01	43.0 – 44.0	981013	3b	10	PBT	c. 2	
KG0048A01	44.0 – 45.0	981013	3b	11	PBT	c. 2	
KG0048A01	45.0 – 46.0	981013	3b	12	PBT	c. 2	
KG0048A01	46.0 – 47.0	981014	3b	13	PBT	c. 2	
KG0048A01	47.0 – 48.0	981014	3b	14	PBT	c. 2	
KG0048A01	50.0 – 51.0	981014	3b	15	PBT	c. 2	
KG0048A01	53.0 – 54.7	981015	3b	16	PBT	c. 2	
KG0021A01	0.0 – 48.82	981130	3b	18	I	c. 1.5	
KG0021A01	7.0 – 10.0	981202	3b	19	PBT	c. 1.5	
KG0021A01	10.0 – 13.0	981202	3b	20	PBT	c. 1.5	
KG0021A01	19.0 – 20.0	981204	3b	21	PBT	c. 1.5	
KG0021A01	20.0 – 21.0	981204	3b	22	PBT	c. 1.5	
KG0021A01	21.0 – 22.0	981205	3b	23	PBT	c. 1.5	
KG0021A01	22.0 – 23.0	981205	3b	24	PBT	c. 1.5	
KG0021A01	23.0 – 24.0	981205	3b	25	PBT	c. 1.5	
KG0021A01	24.0 – 25.0	981206	3b	26	PBT	c. 1.5	
KG0021A01	25.0 – 26.0	981206	3b	27	PBT	c. 1.5	
KG0021A01	26.0 – 27.0	981206	3b	28	PBT	c. 1.5	
KG0021A01	27.0 – 28.0	981207	3b	29	PBT	c. 1.5	
KG0021A01	28.0 – 29.0	981207	3b	30	PBT	c. 1.5	
KG0021A01	29.0 – 30.0	981207	3b	31	PBT	c. 1.5	
KG0021A01	30.0 – 31.0	981208	3b	32	PBT	c. 1.5	
KG0021A01	31.0 – 32.0	981208	3b	33	PBT	c. 1.5	
KG0021A01	32.0 – 33.0	981208	3b	34	PBT	c. 1.5	
KG0021A01	33.0 – 34.0	981209	3b	35	PBT	c. 1.5	
KG0021A01	35.0 – 36.0	981209	3b	36	PBT	c. 1.5	
KG0021A01	36.0 – 37.0	981209	3b	37	PBT	c. 1.5	
KG0021A01	37.0 – 38.0	981210	3b	38	PBT	c. 1.5	
KG0021A01	38.0 – 39.0	981210	3b	39	PBT	c. 1.5	
KG0021A01	40.0 – 41.0	981210	3b	40	PBT	c. 1.5	
KG0021A01	42.0 – 43.0	981211	3b	41	PBT	c. 1.5	
KG0021A01	43.0 – 44.0	981214	3b	42	PBT	c. 1.5	
KG0021A01	44.0 – 45.0	981214	3b	43	PBT	c. 1.5	
KG0021A01	45.0 – 46.0	981215	3b	44	PBT	c. 1.5	